System and method for monitoring a rapid de-excitation system for synchronous machines

[a]Carlos A. Platero, [a]Ricardo Granizo, Emilio Rebollo & [a]Francisco Blánquez.

[a]Technical University of Madrid / ETSII /GELEO (carlosantonio.platero@upm.es)

Abstract

A system and method for monitoring a rapid de-excitation system for synchronous machines (1) with indirect excitation, via an exciter machine (2) and a rotating rectifier bridge (8), comprising:

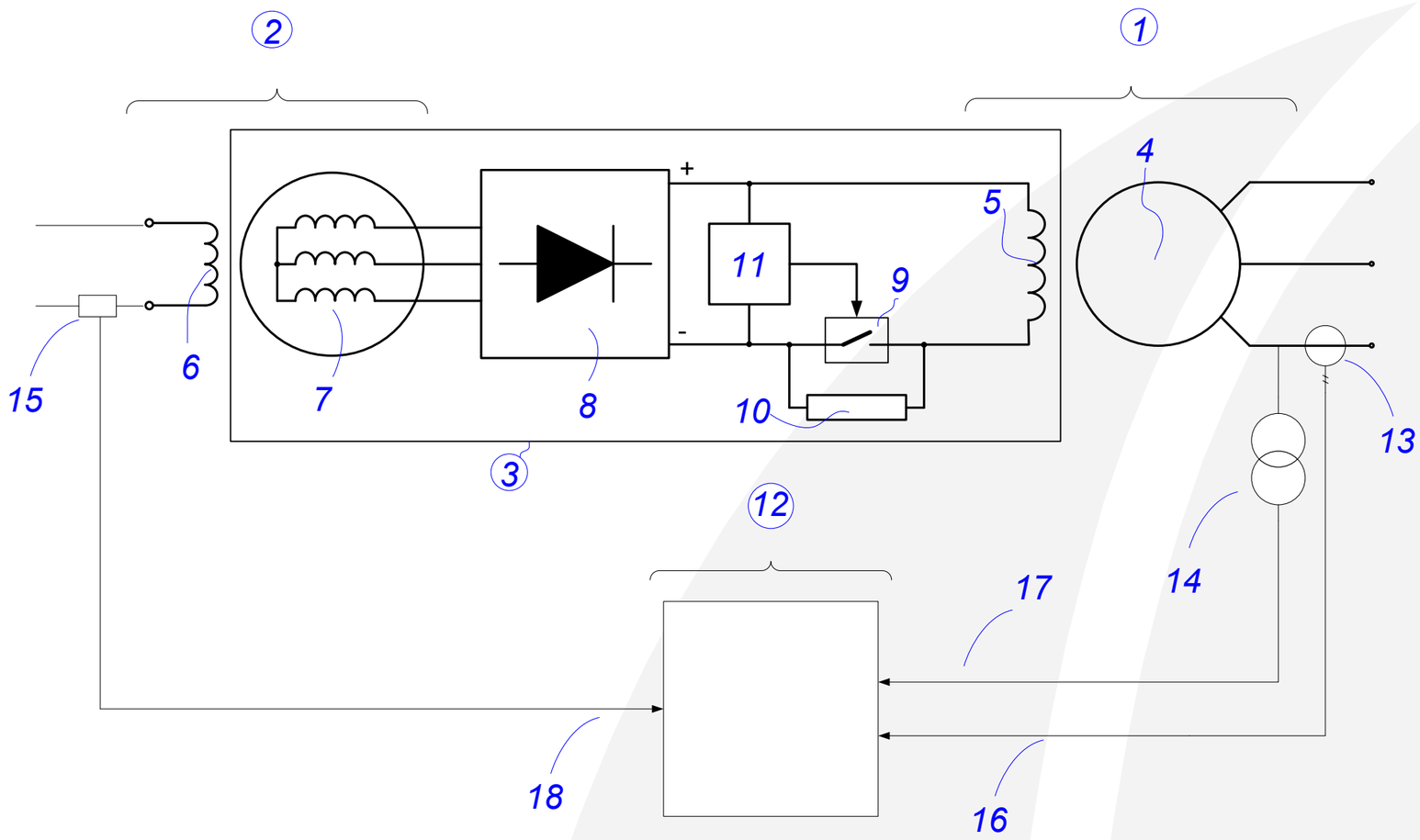
-means for measuring the current (13) and voltage (14) of the stator (4) of the synchronous machine (1);

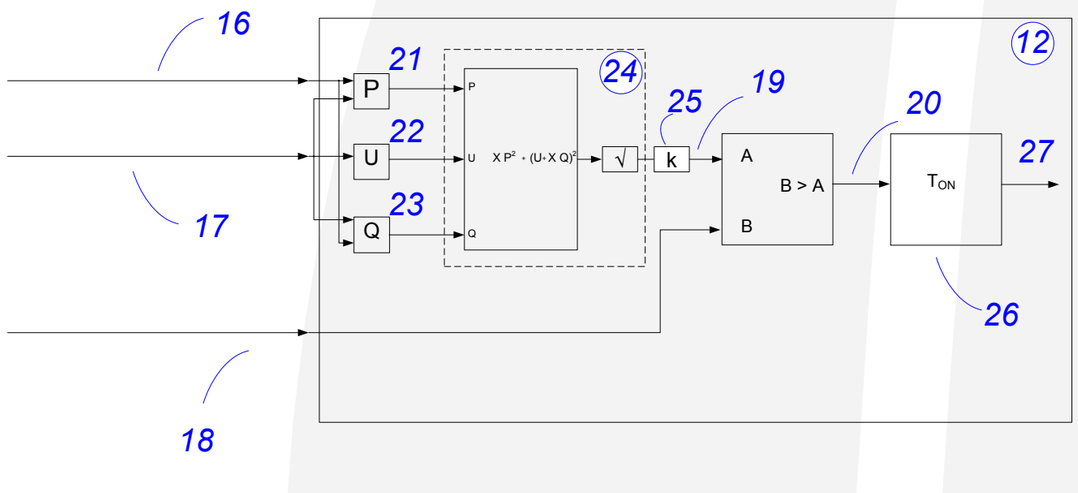
-means for measuring the excitation current (15) of the exciter machine (2);

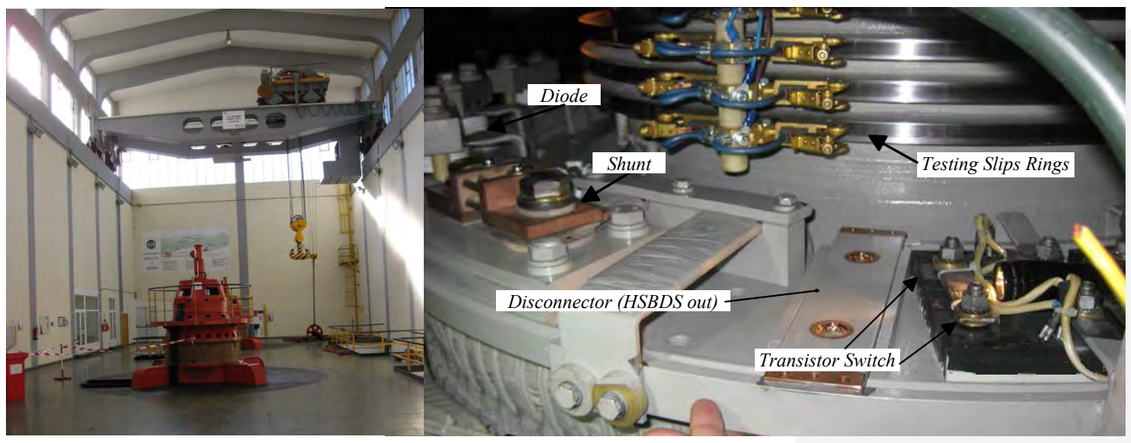
-estimation means (24) for obtaining the estimated excitation current (19) of the exciter machine (2) from the current (16) and voltage (17) values measured in the stator (4) of the synchronous machine (1);

- a module (28) for comparing the measured excitation current Imed (18) with the estimated excitation current Iest (19), in such a way that:

- •there is either incorrect operation if Imed > . Iest + A, where k and A are real numbers determined on the basis of each machine;
- •or else there is correct operation.







HPP Quereño. HSBDS in operation in a 20 MVA Hydro generator.

Conclusions

- HSBDS supervision has been into commercial operation in four 20 MVA / 40 MVA hydro generators since September 2013, without remarkable troubles.
- Patents

P2012231071

PCT/ES2013/000160

WO2014/009576 A1
USA 14412303

Rapid de-excitation system for synchronous machines with indirect excitation

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Abstract

Synchronous machines with brushless excitation have the disadvantage that the field winding is not accessible for the de-excitation of the machine. This means that, despite the proper operation of the protection system, the slow de-excitation time constant may produce severe damage in the event of an internal short circuit.

A high-speed brushless de-excitation system (HSBDS) for these machines was developed in our Laboratory. First a laboratory 5 kVA prototype and after the test in a 15000 kVA machine in Alstom factory (Bilbao), 4 Hydro generator are in service with this HSBDS.

P20090468 PCT/ES2010/000058

The invention relates to a rapid deexcitation system for synchronous machines (1) with indirect excitation by means of an excitation machine (2) and rotating rectifier bridge (8) comprising:

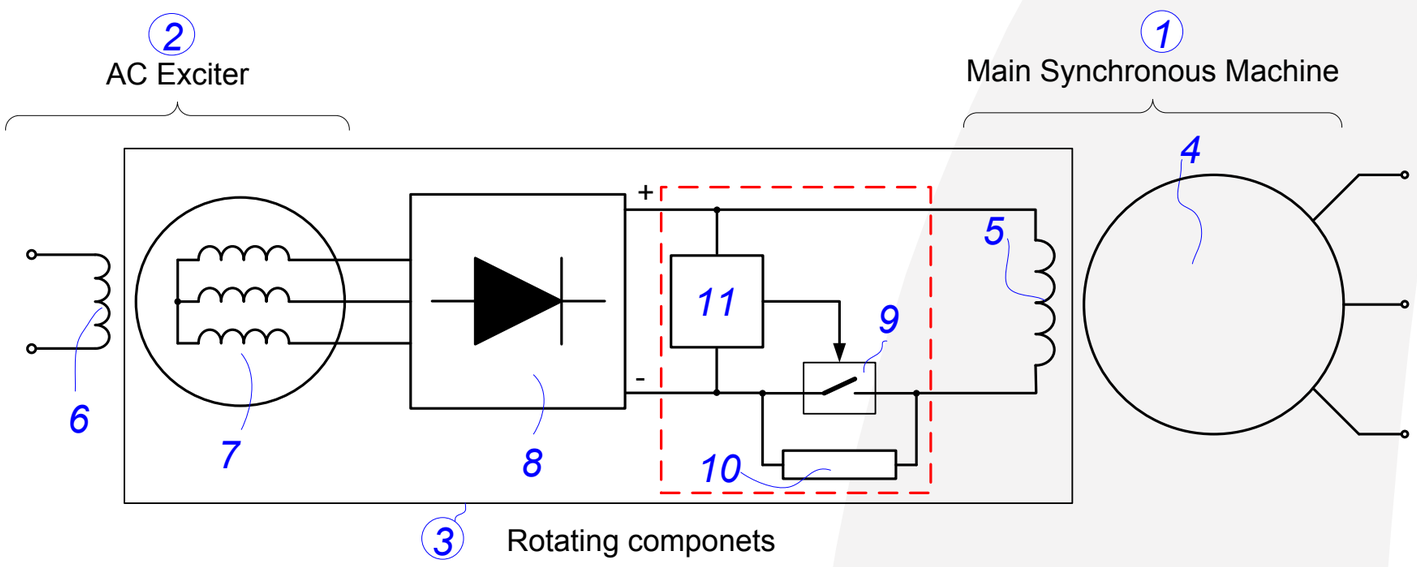
- a deexcitation impedance (10) connected between the field winding (5) of the synchronous machine (1) and the rotating rectifier bridge (8);

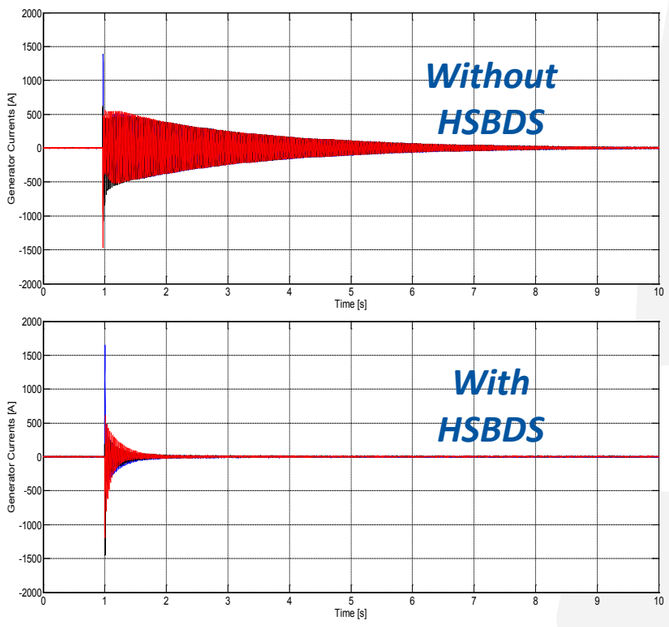
- a controller (9) connected in parallel with the deexcitation impedance (10);

- a control circuit (11) of the controller (9) configured to:

• keep the controller (9) closed such that the rotating rectifier bridge (8) directly feeds the field winding (5) of the synchronous machine (1) during normal operation of the synchronous machine (1);

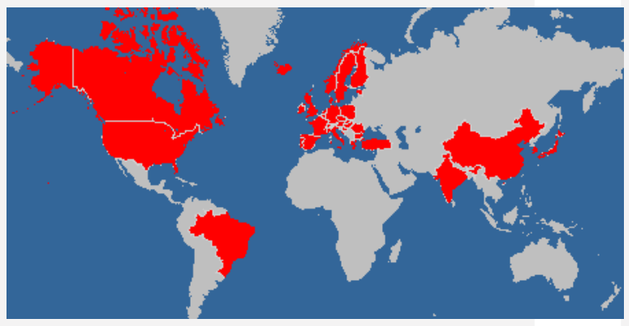
• open the controller (9) such that the deexcitation impedance (10) remains in series with the field winding (5) and with the rotating rectifier bridge (8) when the synchronous machine is to be deexcited





15 MVA Brushless Synchronouos Generator. GE Alstom Factory.

Country	Date	Application Number
India	01/08/2011	5862/DELNP/2011
Canada	08/08/2011	CA2751943
China	12/08/2011	201080007623.1.
USA	17/08/2011	13/201,971.
Brasil	18/08/2011	PI1008626-9.
South Korea	18/08/2011	10-2011-7019197
Europe EPO	16/09/2011	EP10743430.0.



Conclusions

- HSBDS has been into commercial operation in four 20 MVA / 40 MVA hydro generators since September 2013, without remarkable troubles.
- The sudden short circuit tests in a 15 MVA show that the I^2t can be reduced 10 times.
- Patents

P20090468

PCT/ES2010/000058

PROCESS OF FUNGAL BIODEGRADATION ON GROUND TYRES

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Bioingeniería y Materiales

Abstract

The present biodegradation process consists in the use of a fungus, *Paecilomyces lilacinus* IMI 117109, for the degradation of commercial ground tyre rubber. Prior to the biodegradation treatment, the tyre crushing is washed to eliminate possible contaminations that may interfere with the process. Subsequently the fungus is cultured in the presence of the tyre rubber in a liquid medium and shaking conditions. In a second step, the excess of liquid medium is removed. After the incubation period, the growth of the fungus in the material can be observed and its degradation is showed. This process of fungal biodegradation is an alternative to the degradation processes currently employed, allowing to reduce the accumulation of used tyre rubber and taking advantage of the products of its biodegradation for its reuse in the tyre industry or its use in other industrial processes.

Overview

The latest official data indicate that in Spain more than 250,000 tonnes of used tyres are generated annually and it is estimated that there are approximately 4 million tonnes more accumulated in landfills. The current legislation requires the elimination of tyre dumps and the management of the waste by those responsible for placing it on the market.

During the last years biodegradation processes applied to polluting materials have been developed with a view to the subsequent use and reuse of their components. The biodegradation of rubber is a matter of great interest because it could be a complementary path to the existing tyre management.

The process of vulcanization suffered by natural rubber in tyres is responsible for its desirable mechanical and thermal properties but, at the same time, it makes more complex to reuse them. This process forms disulfide bridges between the polymer chains. Further steps during the manufacture of the tyres involve the addition of multiple additives, required for vulcanization or the acquisition of various properties in the final product. Such additives are mostly toxic, introducing an additional problem to the biodegradation process.

In this patent a biodegradation process for commercial ground tyre rubber (**Fig. 1**) is described using the fungus *Paecilomyces lilacinus* IMI 117109. Fungal growth is an unmistakable sign of the biodegradation process that is taking place in tyre grinding (**Fig. 2**).

Fig. 1 Commercial ground tyre rubber used as starting material.

Description and main features of the invention

1) Minimal culture medium

In order to carry out the biodegradation of the commercial ground tyre rubber the fungus is cultivated in a liquid medium of mineral salts in which the tyre crushing constitutes the only source of carbon for the microorganism.

Fig.2 Low temperature scanning electron microscopy (LT-SEM) image of the fungus growing inside the commercial ground tyre rubber.

2) Material cleanness

Prior to the incubation of the tire with the fungus, the grind is washed under certain conditions: ratio of crushed weight / volume of sterile water used, temperature, agitation and time. This washing removes the organic residues and microorganisms that could interfere or displace the biodegradation reaction.

3) Two-phase cultivation

The cultivation of the fungus with the ground tyres in the medium of mineral salts is carried out in two phases. In the first one an excess of liquid medium and agitation is used. This phase is necessary for the activation and correct distribution of the fungus in the material. In the second phase, the excess of liquid medium is removed, leaving a static solid-wet culture, in which the fungus continues growing on the crushed.

4) Possibility of using other microorganisms

This biodegradation process can be applied employing other microorganisms as long as they possess the metabolic capabilities for the degradation of the ground tyre, adapting the culture conditions to the particular physiology of the selected microorganism.

Patent information

Title: Procedimiento de biodegradación fúngica de triturado de neumáticos.
Inventors: Ruibal Villaseñor, Constantino; García Ruiz, Ana María; Moreno Gómez, Diego Alejandro; Benavides Ruiz, Enrique
Applicant: Universidad Politécnica de Madrid
Publication number: ES 2 293 864 (A1) (B2)
Application number: 200703236
CPC: C08J11/10; C12N1/14; Y02W30/702
IPC: C08J11/10; C12N1/14
Priority date: 2007-12-05

BIOREMEDIATION METHOD WHICH IS USED TO CONCENTRATE AND ELIMINATE RADIONUCLIDES IN RADIOACTIVE WATER

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Bioingeniería y Materiales

Abstract

A completely innovative bioremediation procedure has been invented to concentrate and eliminate radionuclides from the radioactive water of nuclear pools. This method is based on the capacity of microorganisms to retain radionuclides when they are growing by forming biofilms on the colonized surfaces. Preferably the bioremediation is performed before the water is passed through demineralizing filters to prolong the life of such filters. As a result, there is less radioactive waste to be managed, thereby increasing the profitability of the method.

Main features of the invention

Currently the radioactive water of the nuclear pools is treated with a system of demineralising filters made from ion-exchange resins whose goal is to retain the dissolved substances and those in suspension that can be found in the water, such fission and corrosion products, etc. so that the water is much clearer and the radioactivity in the area surrounding the pools is significantly lower. As time passes, the life expectancy of the resins is lowered and it is necessary to store them in drums and to treat them as radioactive waste. The new bioremediation procedure, however, retains the nucleotides found in the radioactive water before they reach the resin of the demineralising filters, and as a result, increase their life expectancy, thus reducing the volume of radioactive material to be managed.

In this patented procedure, the radioactive water from the nuclear pools under treatment, goes through a bioreactor (**Figures 1 and 2**) that contains a metallic material, such as titanium or stainless steel, wound into a ball, or any other material that is non-corrosive or non-degradable in this environment and can be colonised by the microorganisms that exist in this type of water. As it goes through the bioreactor, the radioactive water to be treated comes into contact with the material of the ball placed inside, thus forming a biofilm (**Figures 3, 4, and 5**) that retains the radionuclides. The water then goes out from the opposite end of the continuous-flow entrance and, before going back into the pool, it goes through a system of demineralising filters.

Biofilms developed on the balls were analyzed by scanning electron microscopy and epifluorescence microscopy. DNA was extracted from the biofilms, was cloned and the microorganisms were identified by sequencing. The identified radioresistant organisms belong to the phylogenetic groups *Alpha-proteobacteria*, *Gamma-proteobacteria*, *Actinobacteria, Deinococcus-Thermus* and *Bacteroidetes*. These microorganisms are capable of retaining the radioisotopes present in the water of the pools by one or more of the following mechanisms: bioadsorption, bioabsorption, bioaccumulation, biosolubility, bioprecipitation.

By gamma spectrometry we also determined that biofilms have essentially retained activation radionuclides. Sometimes the sum of Co-60 and Mn-54 reached 98%. Cr-51, Co-58, Fe-59 Zn-65 and Zr-95 have also been retained by the developed biofilms.

It has been assessed that the scalable process can be economically profitable.

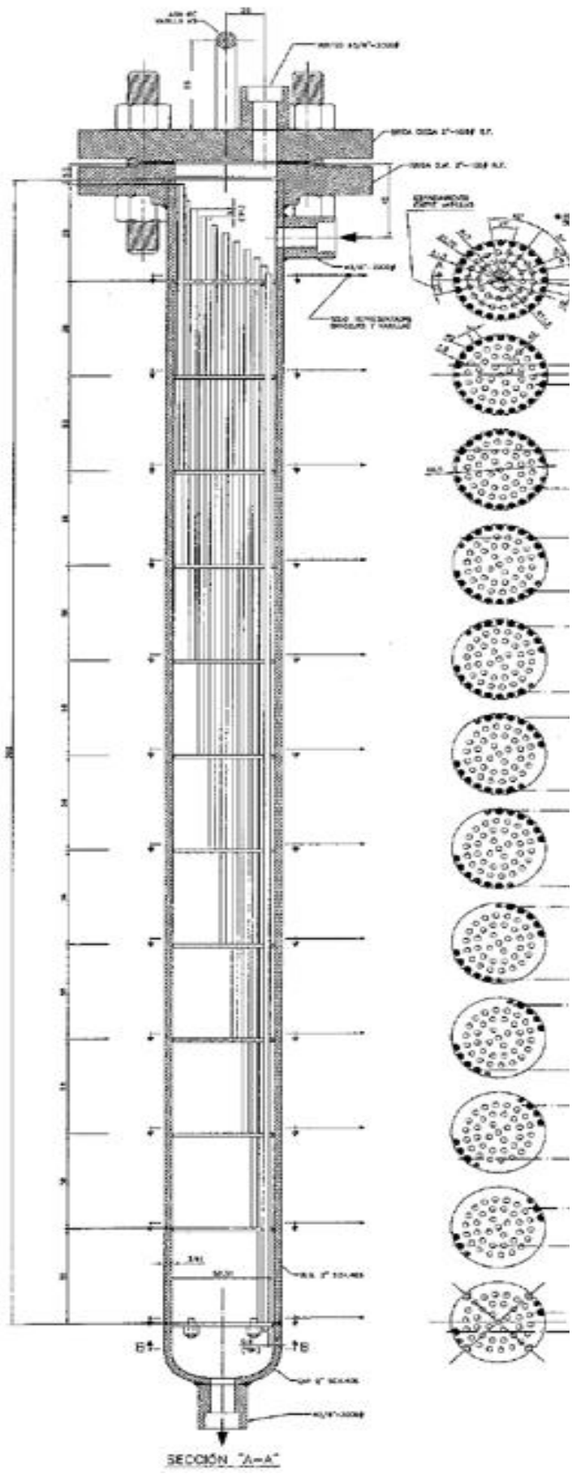

Fig. 1. Cross-section of bioreactor.

Fig. 2. Top view of the bioreactor made of stainless steel .

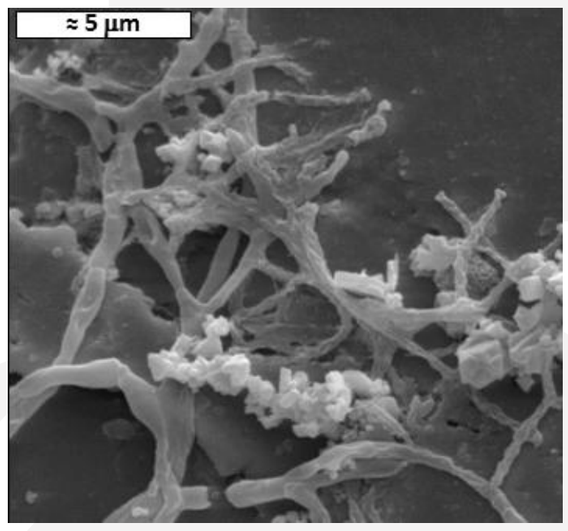

Fig. 3. Biofilm developed on stainless steel balls after 186 days immersion.

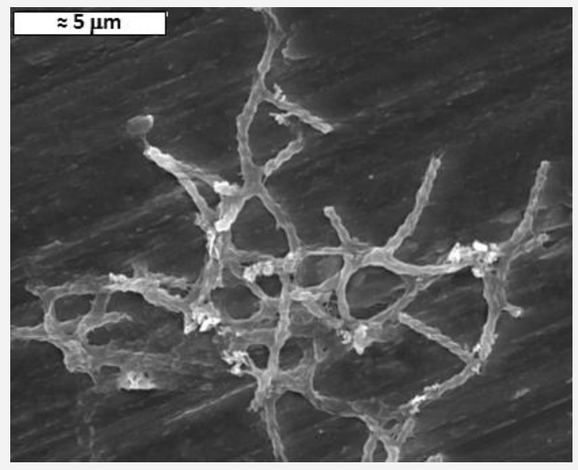

Fig. 4. Biofilm developed on titanium balls after 97 days immersion.

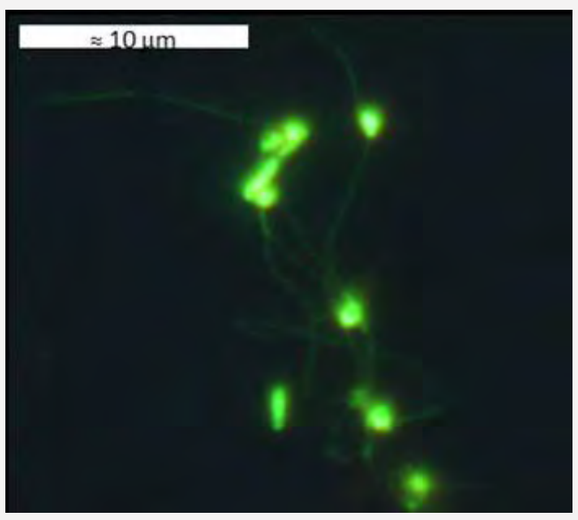

Fig. 5. Biofilm of *Pedomicrobium* sp. on titanium balls at 218 days immersion.

TECHNOLOGICAL SECTOR TO WHICH THE INVENTION RELATES

Nuclear power industry and management of radioactive water

Patent information

Title: *Procedimiento de biorremediación para concentrar y eliminar radionúclidos en aguas radiactivas*
Inventors: Diego A. Moreno (UPM), Felipe Montero (Iberdrola Generación SA)
Applicant: Universidad Politécnica de Madrid
Publication number: ES2190758 A1 **Application number:** P200200006 **Priority date**: 2002-01-02
Publication number: US7326345 B21 **Application number:** US 10/500,222 **Priority date**: 2008-02-05
CPC: Y02W10/15, Y10S210/912, C0F2101/006, C02F3/10, G211F9/18 **IPC:** C02F2101/006, C02F3/10, G21F9/18

PORTABLE AND AUTONOMOUS DEVICE FOR AIRBORNE PARTICLES COLLECTION

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Bioingeniería y Materiales

Abstract

A portable device for collecting airborne particles with autonomous operation, comprising a container (1) having an inlet (2) of air from outside into the container (1), and an outlet (3) of air from inside the container (1) to the outside; so that between the inlet (2) and outlet (3) of air, the container (1) comprises, inside, a first module (7) for capturing airborne particles, which in turn comprises: a first means of filtering (4) for the air, allowing the passage of air and particles smaller than the pore size; and a first receptacle comprising, in turn, a first plate (5) covered with a tacky substance or other adhesive surface on its anterior major surface and configured to collect, at least, part of the particles present in the air (**Fig. 1**).

Overview

In addition to gases and inorganic particles, the air carries many biological particles such as pollen, fungi, bacteria and viruses. Some can trigger allergy symptoms in the population and be also the cause of airborne disease transmission like the flu, pneumonia and legionellosis. Crops and farm productivity are also affected by these airborne organisms, causing an important economic impact. The monitoring and detection of all this biological diversity in the air outdoor is a difficult task because of their particular characteristics regarding size, relative abundance, residence time in the atmosphere… Hence, the different biological particles are usually studied independently.

To solve these troubles, we have developed an equipment attachable to any kind of vehicle to collect all the biological particles present in the air (sorting by size if desired), and keeping the sample intact for further biochemical detection (e.g. DNA sequencing) or identification by microscopy.

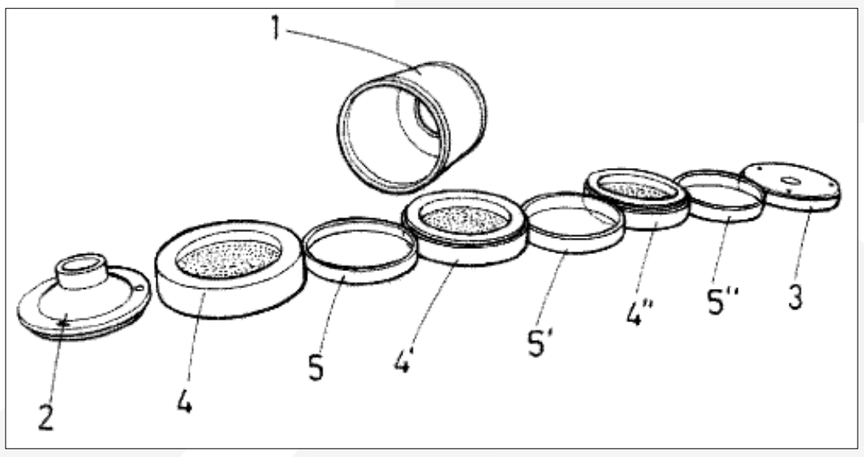


Fig. 1 Scheme showing the components of the device.

Main features of the invention

1) Autonomy and simplicity

Collection is performed passively, promoted by the advance of the vehicle, forcing the air to pass through the equipment. The particles are harvested and retained inside the device on an adhesive surface. Therefore, electric power is not required and the operating time is unlimited.

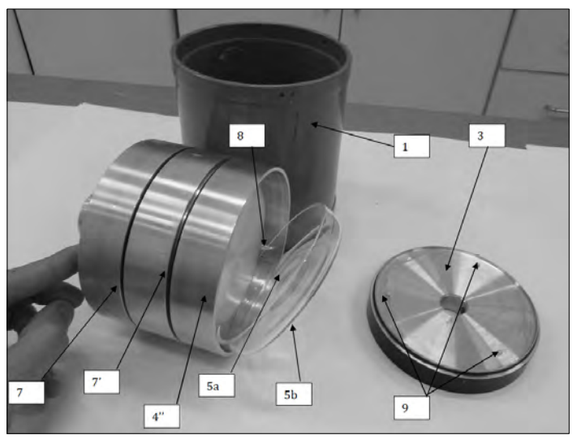


Fig. 2 Picture of the modules and the different parts of the device.

2) Modular structure

The filtering (4) and collection (5) components have a modular organization (7), so it is possible to add or remove modules in order to increase the collection surface or select different size for the particles to harvest in each module (**Fig. 2**).

3) Reusable: brand-new

The prototype is made of metal and glass to be cleaned easily and sterilized in the autoclave, so the components can be used over and over to collect fresh samples.

4) Built to be linked to any vehicle

The cylindrical design, small size and light weight make it simple to attach to many platforms and different means of transport such as cars, buses, airplanes, UAVs, ships… (**Fig. 3**), increasing the options of collection times and the places where the air samples can be taken.

5) Upgradable

Additional features like lids to control the collection, a flow-meter coupled with a data-logger to monitor the volume of air sampled, the use of disposable collection receptacles… can be easily integrated in the equipment to improve its performance.

Fig. 3 Pictures of the equipment attached to different vehicles.

Patent information

Title: Dispositivo captador de partículas presentes en el aire de carácter portátil y autónomo.
Inventors: Núñez Hernández, Andrés, Ana María García Ruiz, Diego Alejandro Moreno Gómez
Applicant: Universidad Politécnica de Madrid
Publication number: ES2558792 **Application number:** ES20150031836
CPC: B01D45/04; G01N1/22 **IPC:** B01D45/04; G01N1/22 **Priority date**: 2015-12-18

INDUSTRIALES RESEARCH MEETING 17

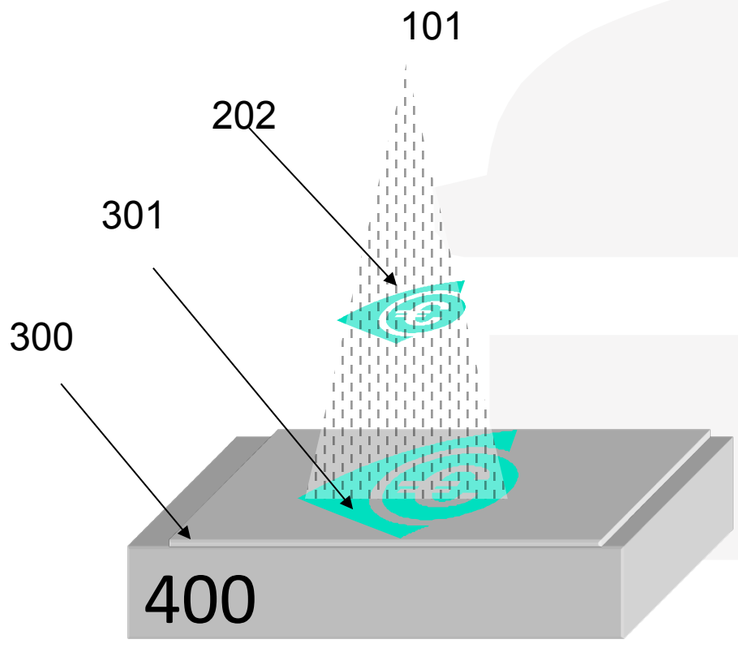
PROCEDURE FOR MARKING, ENCRYPTION, LABELLING AND OPTICAL CODING

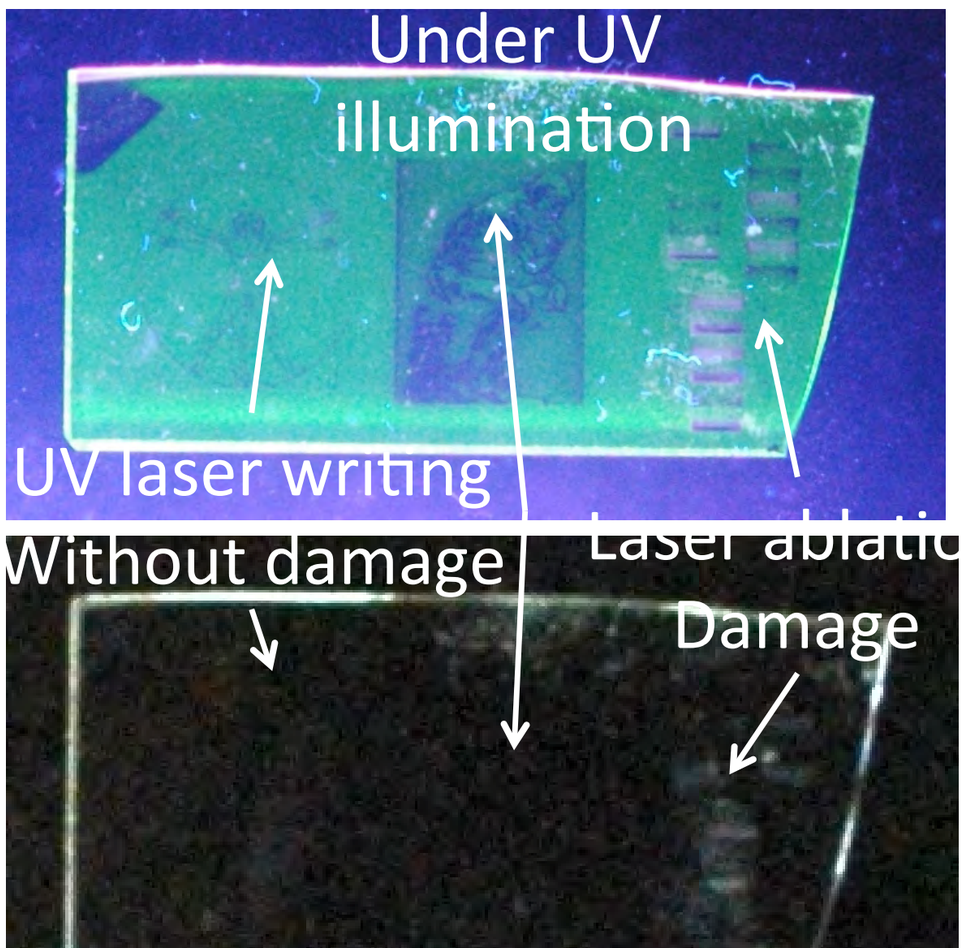
Optics
Fotonics
Biofotonics

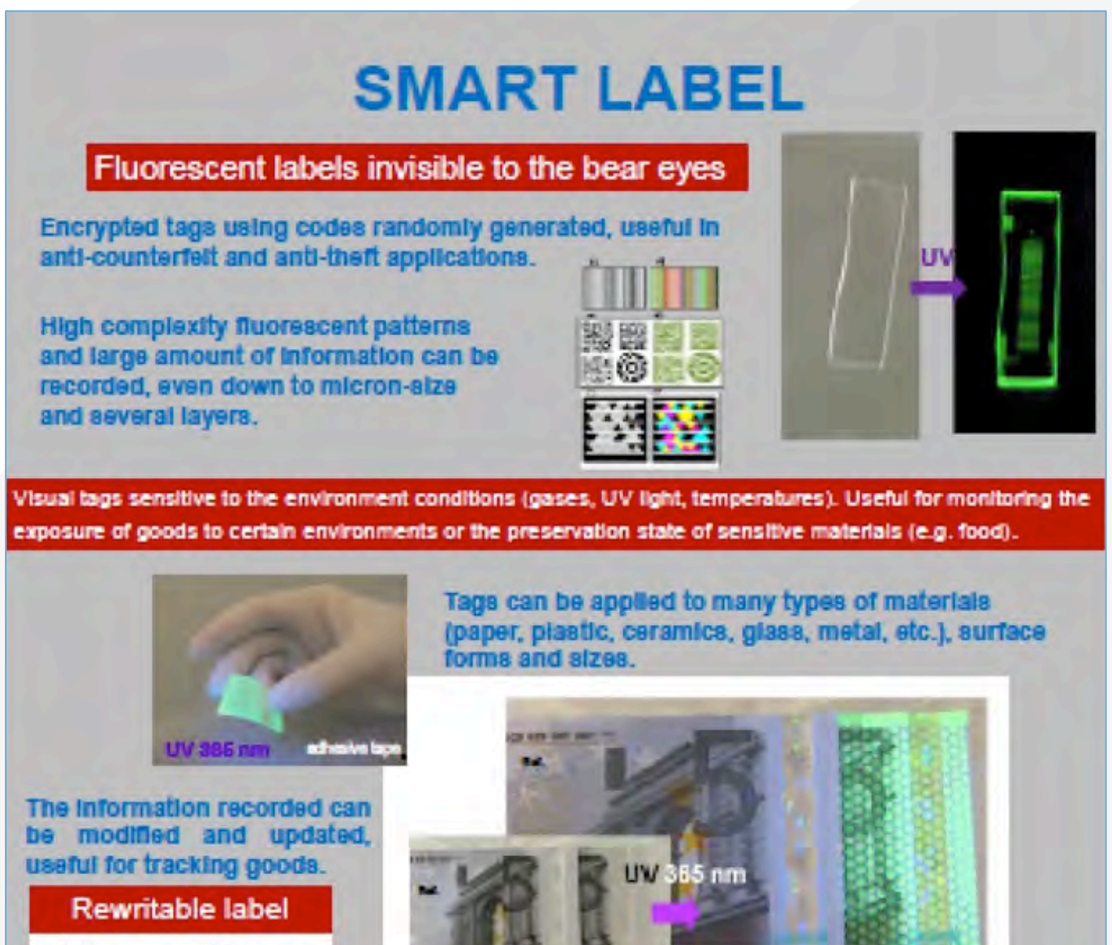
[a]M. Holgado, [b]A. Barranco, [a]R. Casquel. [b]A.R. González-Elipe, F.J. Sanza
[a]M.F. Laguna, [b]Sanchez valen cia Juan Ramon; [b]A Rebollo [a]F.J. Sanza
[A] Corresponding author, UPM (m.holgado@upm.es)
[B] ICMSE-CSIC

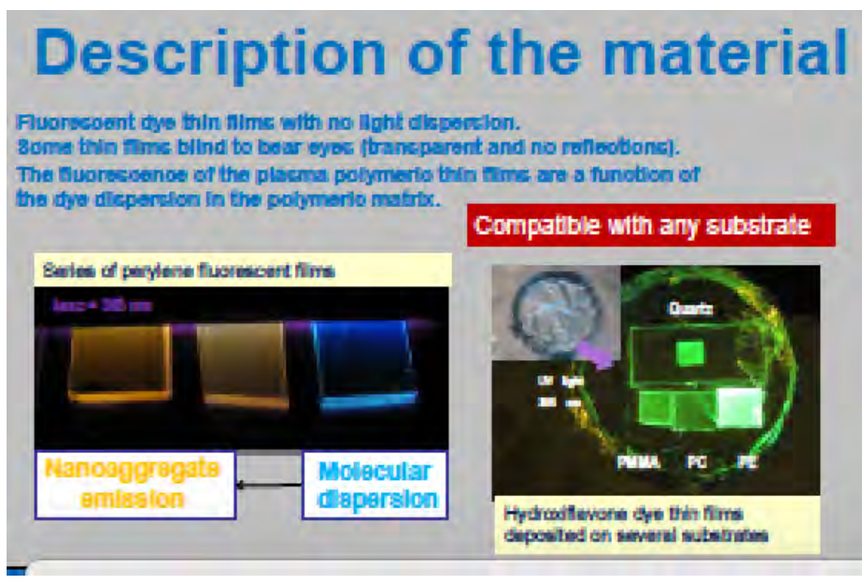
Abstract

It permits marking or recording motifs (301) on surfaces whereon there has been deposited previously a fluorescent polymer layer (300) through a procedure of plasma polymerisation (100) of molecules of a colourant. The procedure combines the special characteristics of the polymer layers making them suitable for being capable of recording diverse motifs (301) thereon, and the possibility of recording by laser (101) or other techniques. Among such characteristics should be mentioned the possibility of a notable visual effect, including for thicknesses of 100 nm, the use of layers non-observable when illuminated with visible light, the high optical quality (transparency) thereof, or the facility wherewith they may be processed by subsequent treatments, including diverse laser treatments

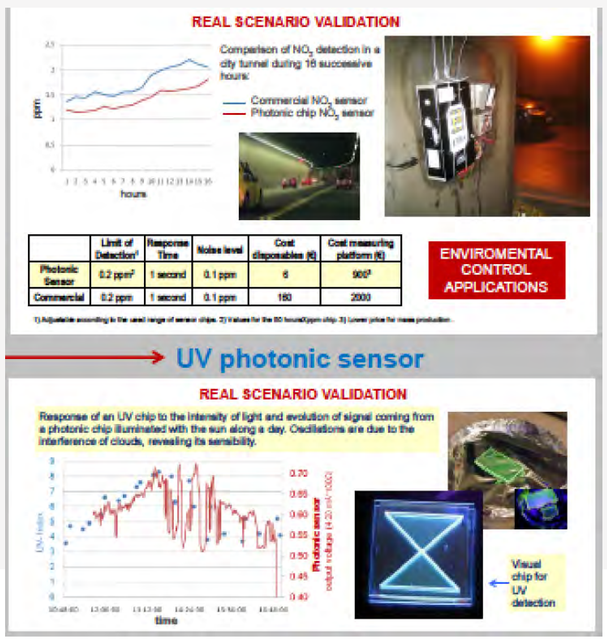


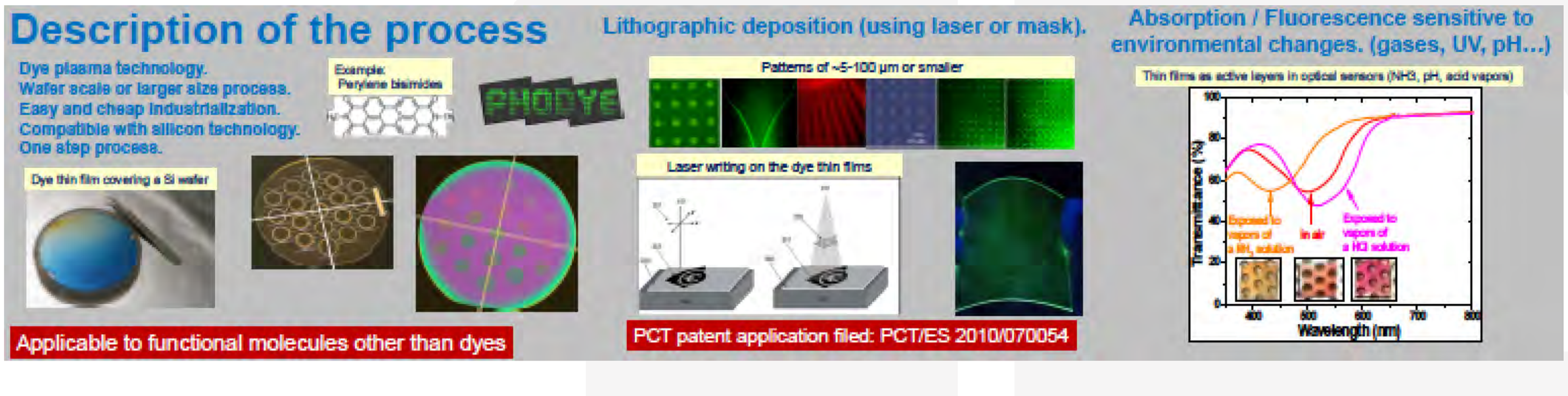







Sistema de micromecanizado ML-100





Interferometric Detection Method

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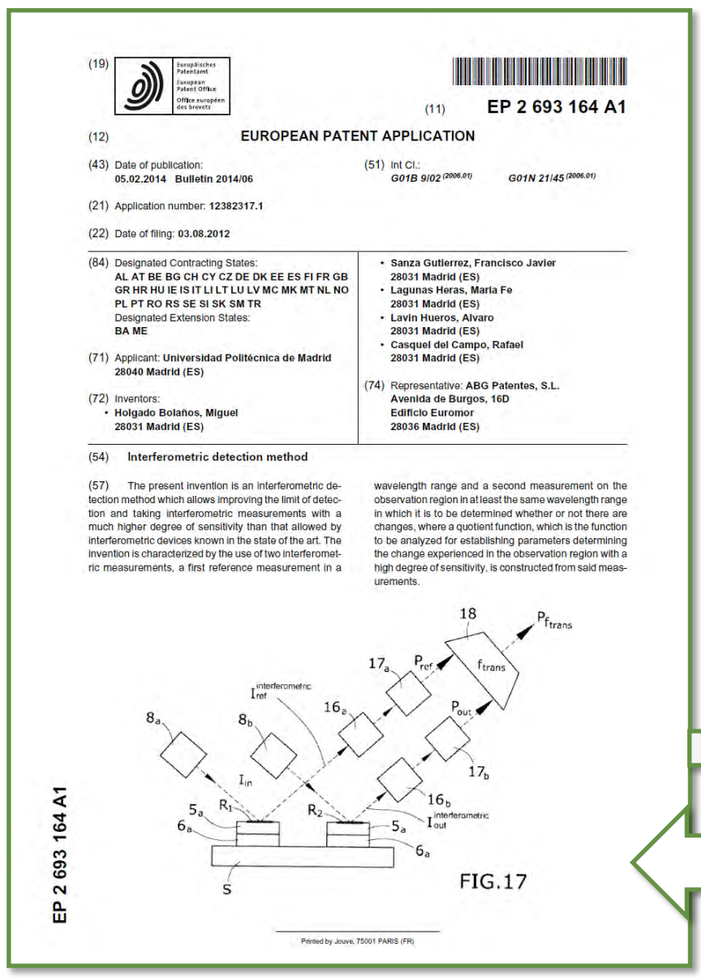
[b] Center for Biomedical Technology (Optics, Photonics and Biophotonics Laboratory)

[c] Bio Optical Detection (Centro de Empresas Campus UPM Montegancedo)

Abstract

The Interferometric Detection Method is characterized by the use of two interferometric signals, which allows for the optical reading system to convert the changes caused by the optical transduction into a unique, sensitive variable of detection. Therefore, two interferometric measurements are used: a first interferometric optical reference, which represents the measured intensity modulated by a reference interferometer; and a second interferometric signal measurement observed in the sensing region of the signal interferometer. The sensing surface region is where changes caused by the biomolecular interaction takes place. A transduction function [f_{TRANS}] is then constructed from the interferometric measurements, and analyzed to determine the biosensing response caused by the biological accumulation in the sensing observation region.



(19) Europäisches Patentamt / European Patent Office / Office européen des brevets

(11) EP 2 693 164 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication: 05.02.2014 Bulletin 2014/06

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(21) Application number: 12382317.1

(22) Date of filing: 03.08.2012

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Designated Extension States: BA ME

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(54) Interferometric detection method

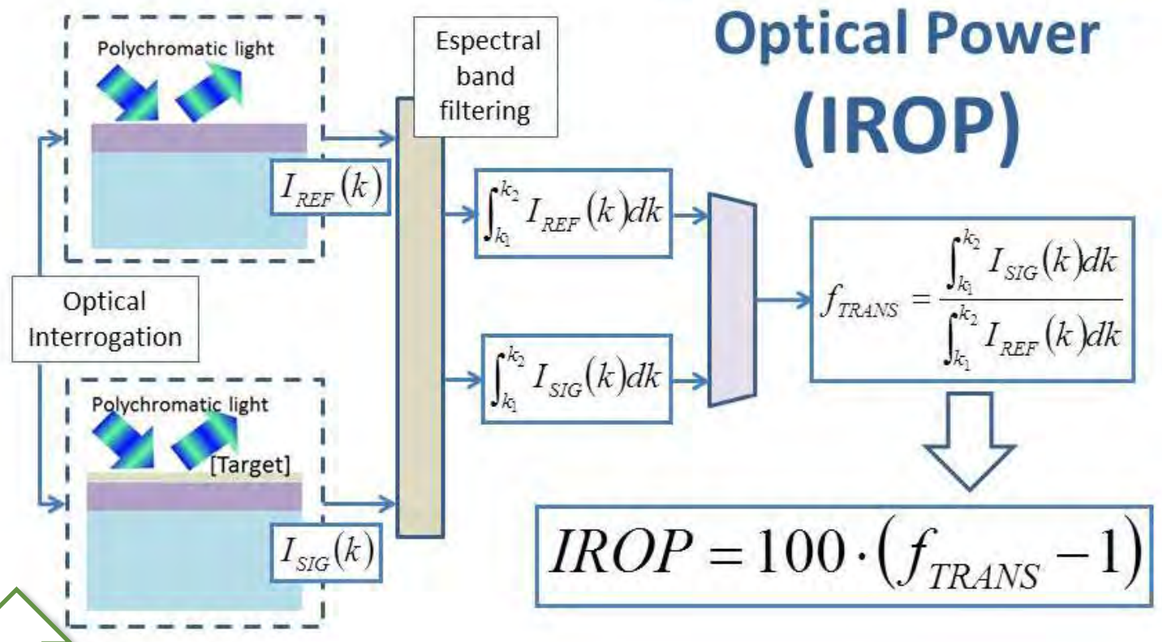
(57) The present invention is an interferometric detection method which allows improving the limit of detection and taking interferometric measurements with a much higher degree of sensitivity than that allowed by interferometric devices known in the state of the art. The invention is characterized by the use of two interferometric measurements, a first reference measurement in a wavelength range and a second measurement on the observation region in at least the same wavelength range in which it is to be determined whether or not there are changes, where a quotient function, which is the function to be analyzed for establishing parameters determining the change experienced in the observation region with a high degree of sensitivity, is constructed from said measurements.

FIG.17

EP 2 693 164 A1

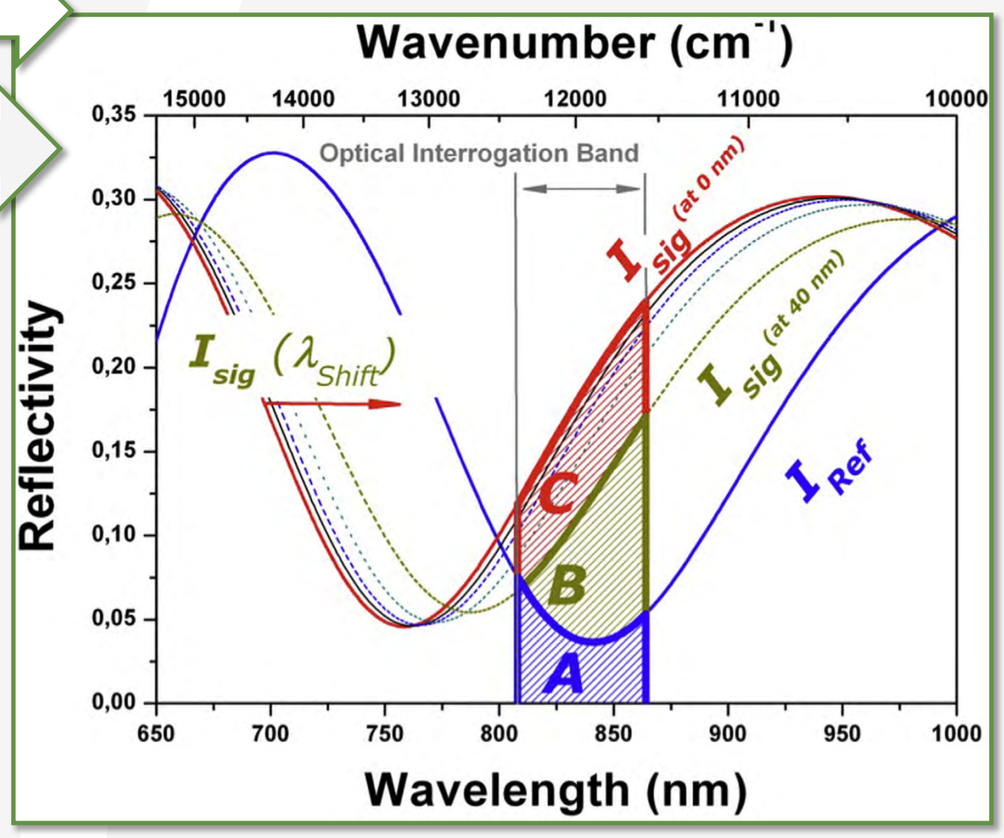
Printed by Jouve, 75001 PARIS (FR)

Increased Relative Optical Power (IROP)

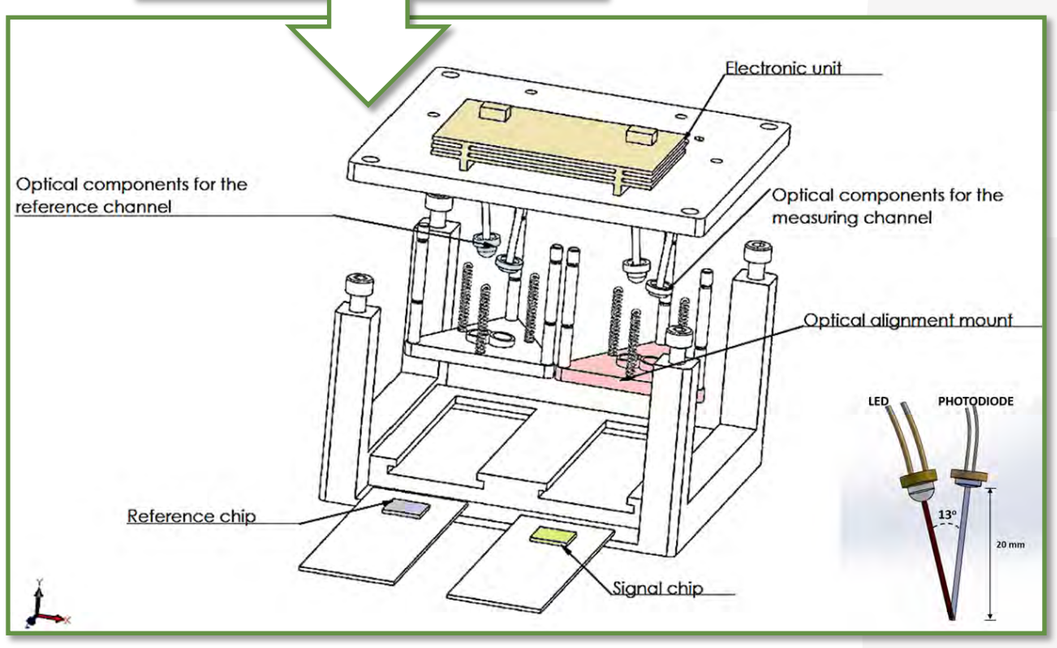


Theoretical Explanation

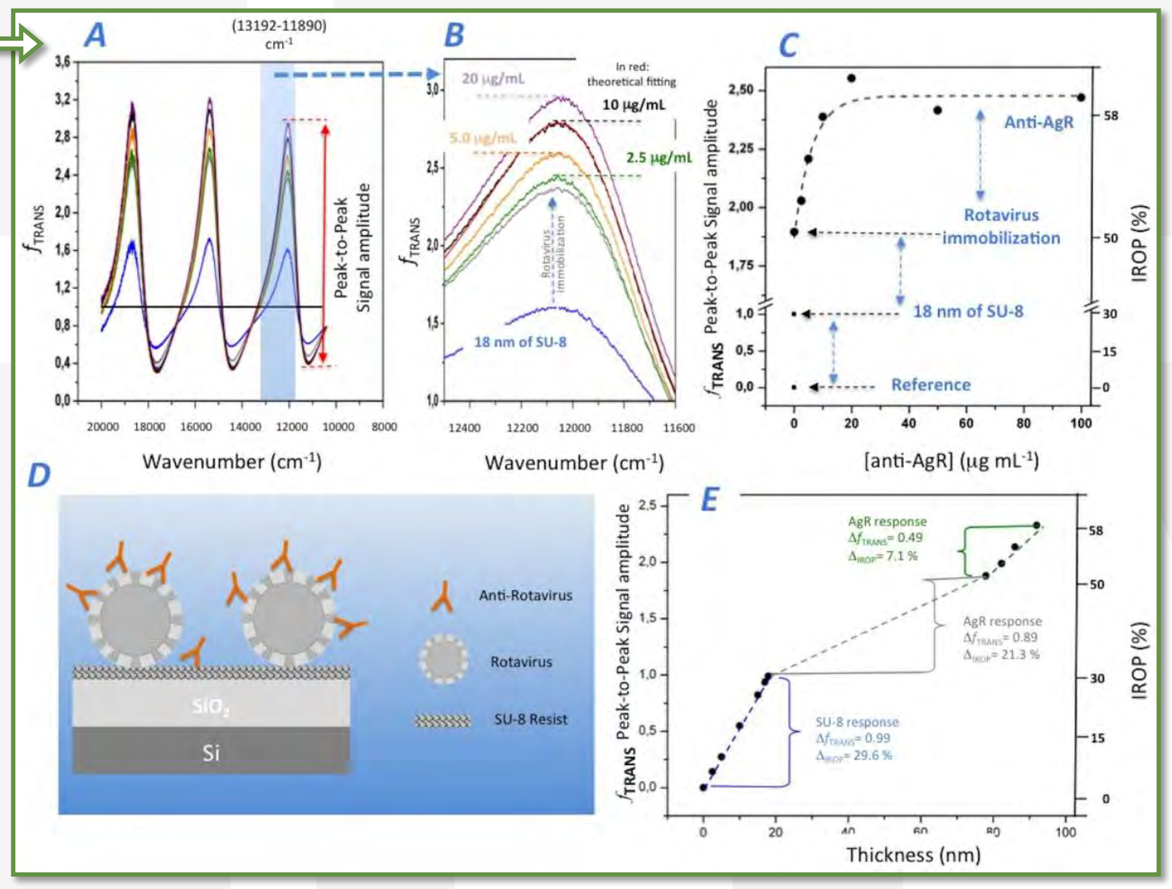
Theoretical calculation of the reflectivity as a function of the wavenumber and wavelength for the reference interferometer and for the signal interferometer. It is also represented the optical interrogation band, which is the spectral range from 808 nm to 864 nm used to obtain the optical power for both interferometers. The capital letters: *A*, *B* and *C*; represent three different situations. *A* is the area defined by the optical interrogation band and the interferometric profile of the Fabry-Perot Interferometer (FPI) used as reference. This area is, therefore, proportional to the optical power of the reference interferometer. *C* and *B* represent two different situations. *C* is the area defined by the optical interrogation band and the interferometric profile of the signal FPI when the biofilm thickness is 0 nm. *B*, represents the area defined by the signal interferometer and the optical interrogation band for a biofilm thickness of 40 nm. As a conclusion, when the biofilm thickness is increased, the spectrometry profile of the signal FPI is closer to the reference FPI, producing a lower level of IROP signal.



Implementation to Point of Care (PoC) devices



Applications



OPTICAL DETECTION SYSTEM FOR LABELLING-FREE HIGH-SENSITIVITY BIOASSAYS

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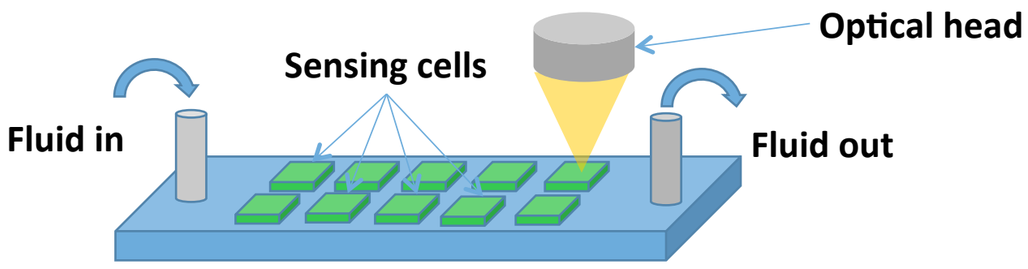
Abstract

The patent describes and optical detection system for labelling-free high-sensitivity bioassays, which comprises the use of optical characterization techniques that allow vertical interrogation in micrometric and sub-micrometric domains and also at least one vertical-interrogation biophotonic interferometric or resonant cell. The system comprises, at least: (i) an optical measuring system that comprises one excitation source, for the detection of the signal and an optical head; and (ii) an element for the integration of multiple analytes, comprising, in turn, and at least, a plurality of biosensitive cells, a plurality of fluid connections connected with the cells, and a substrate on with not only the biosensitive cells but also the fluid connections. The system is designed to perform label-free high sensitivity bioassays, with sensing chips fabricated at wafer scale.

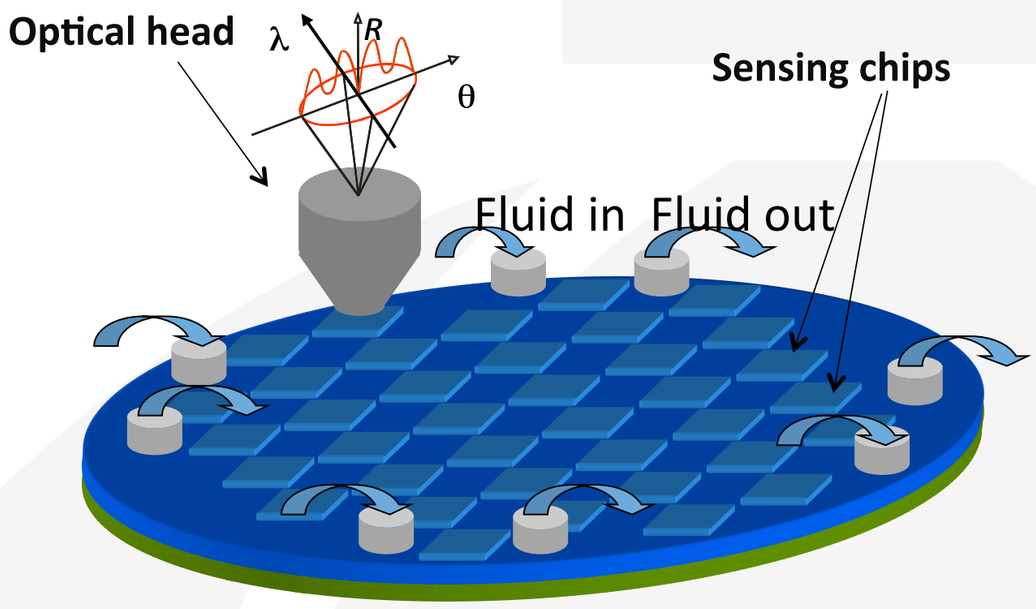
Description of the patent

The system consists of an optical interrogation system (optical head with a detector) and a variety of optofluidic sensing cells. The optical head interrogates vertically the optofluidic sensing cell and obtains three different optical responses in a single measurement: ellipsometry, reflectivity as a function of the angle of incidence, and reflectivity as a function of wavelength.

The optical information is taken using a single measurement, and can be combined and processed. This is interesting in particular for bioassays, because can reduce the uncertainty of the detection.

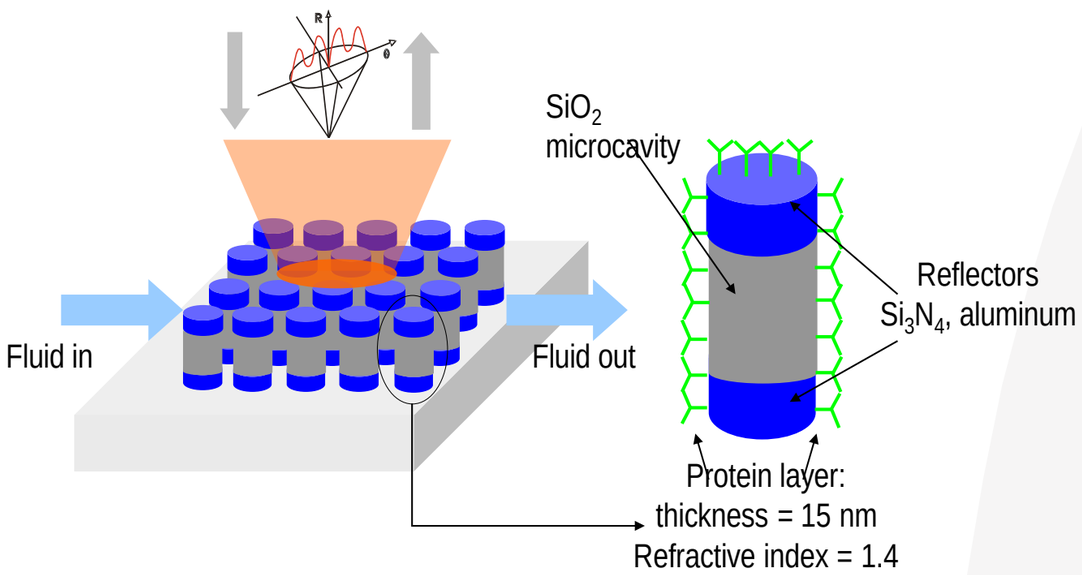


Sensing chip – high multiplexing

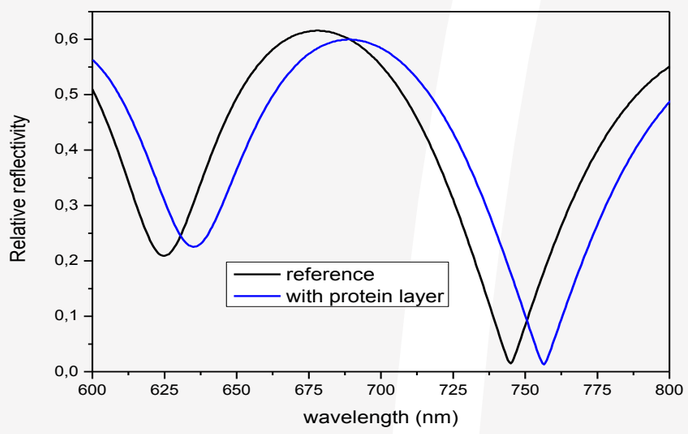


The chips can be fabricated at wafer-scale, High-througput screening

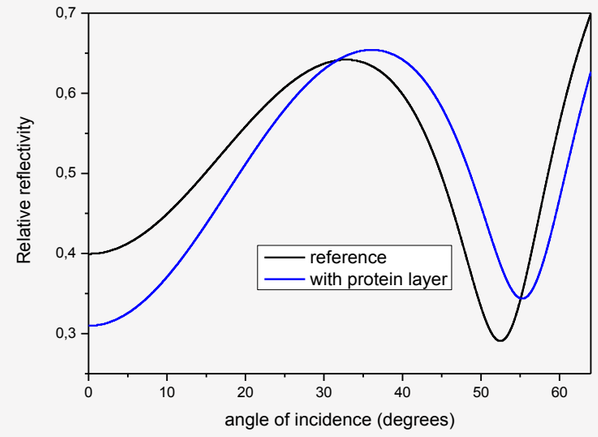
Sensing cell: arrays of Resonant pillars



Reflectivity as a function of wavelength

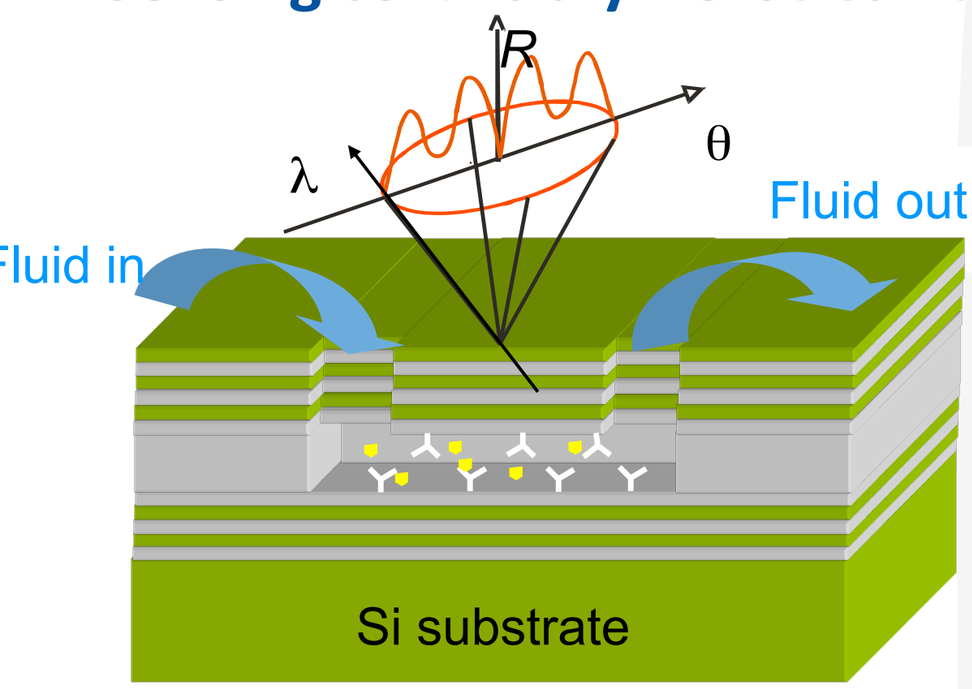


Reflectivity as a function of angle of incidence

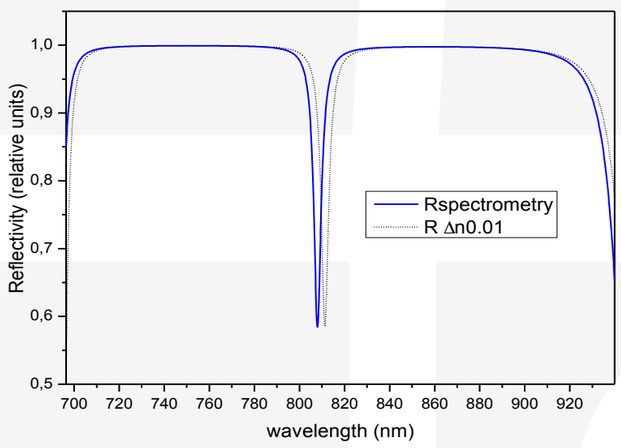


The optical head allows measuring in sub-micrometric domains, even covering a single pillar. The Calculated optical responses are for pillars of 500 nm, with two reflectors of Silicon Nitride, and a central cavity of Silicon dioxide. The bioreceptors cover all the surface of the pillars, enhancing sensitivity.

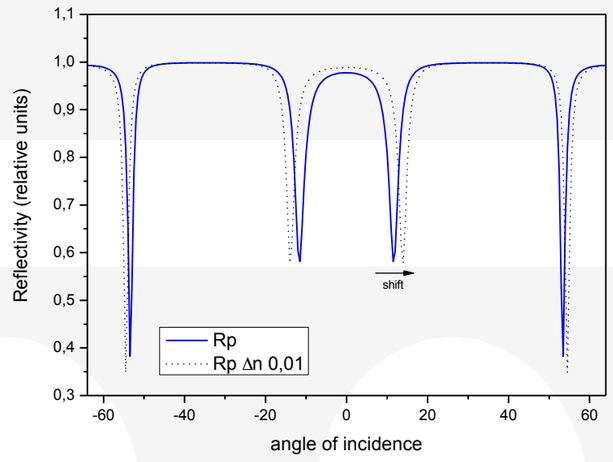
Sensing cell: Fabry-Perot Cavities



Reflectivity as a function of wavelength



Reflectivity as a function of angle of incidence



This sensing cell is designed to obtain a narrow resonance in order to increase the sensitivity of the measurement The cell consist of a Fabry-Perot cavity, with two Bragg Reflectors, of Silicon and Silicon Dioxide, and a central cavity filled with fluid, where the biorecognition takes place. Values of limit of detection for refractive index sensing are in the order of 10^{-5}.

Application number of the patent: **EP20090811139**. **European Patent approved**

INDUSTRIALES RESEARCH MEETING 17

Method and system for estimating the forces and torques generated by the contact of a tire with the road in an instrumented wheel

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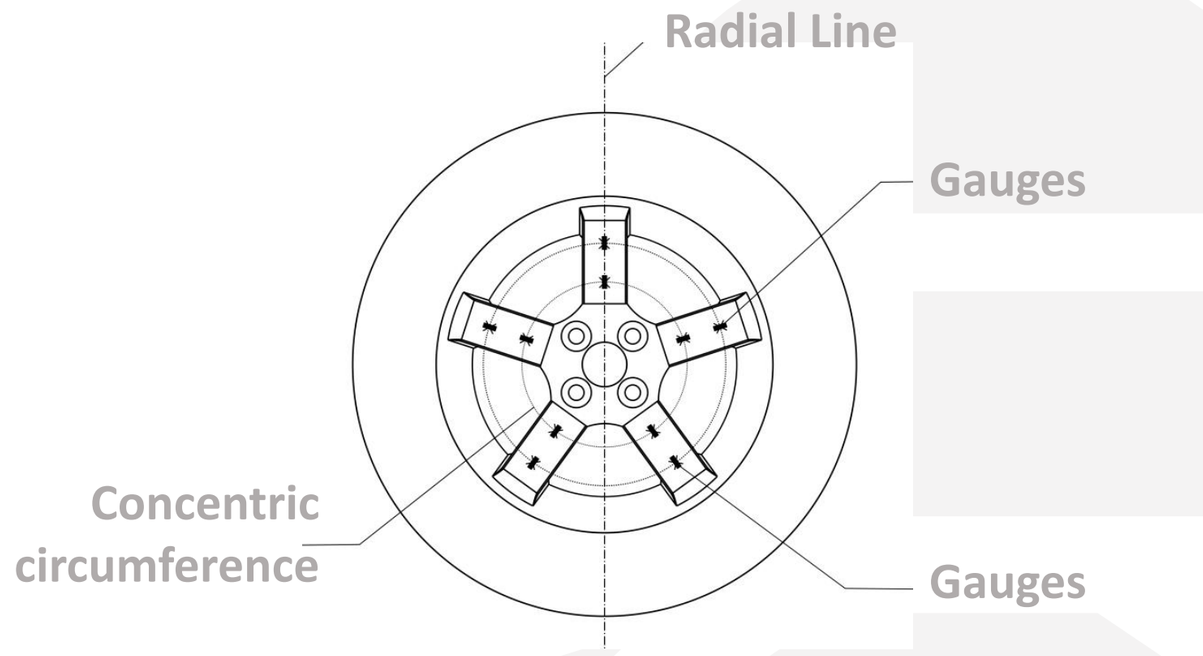
INSIA

Abstract

The invention relates to a method for measuring the forces and the moments generated by the tire-road contact from the combination of unit deformation or strain signals measured in different angular and radial positions of the wheel. The angular positions in which the sensors are placed are those permitted by the geometry of the tire. The combination of deformation signals results in six or more signals that are independent of the angular position of the measuring sensors with respect to ºthe tire-road contact point. The effect of temperature and loads that generate deformation signals that do not depend on said angular position of the measuring points, such as centrifugal forces, have been eliminated from the aforementioned signals. Said signals provide estimates of the loads by means of the resolution of two systems of linear equations with constant matrices and three unknowns each.

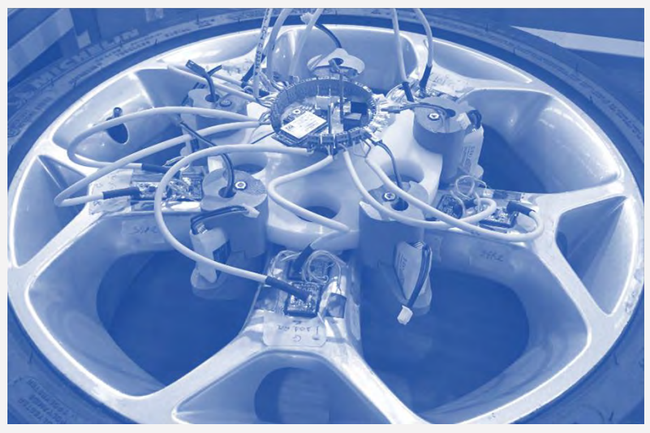


Theory

- The method proposed is based on bonding strain gauges to the rim and on using harmonic elimination techniques. The strain gauges are arranged in concentric circumferences (at least two) and in angularly equidistant radial lines (at least five)

Strain gauges & amplifier boards

- Strain gauges are sensors which can measure deformations, pressures and torques. These sensors have a resistance whose value changes when a deformation occurs. As a consequence, the value of the current changes.



Telemetry

- The current system is based on the WiFi technology. Every signal is broadcaster by wireless. The system is composed by three elements depicted in Fig.

Competitive Advantages of the Solution

- Provides real-time information to dynamic control systems, improving them.
- Price far less than competition that can make it viable to a wider spectrum of researchers and companies.
- Adaptability to a wide range of rims.

Medical devices based on intelligent materials and complex geometries patented and developed during last decade within UPM's Product Development Laboratory

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[c]Professor Emeritus, ETSI Industriales - UPM

Abstract

The Product Development Laboratory (Laboratorio de Desarrollo de Productos) at ETSI Industriales, is the first "fab-lab" from Universidad Politécnica de Madrid. It was founded in 1997 by Prof. Pilar Lafont Morgado and has been running for 20 years providing support to research projects, teaching activities and industrial innovation tasks in all aspects linked to the development cycle of innovative products. Aspects including creativity promotion, intellectual property management, conceptual design, computer-aided technologies for product engineering and rapid prototyping usually by means of additive manufacturing technologies (3D printing) are key areas of expertise of the UPM's Product Development Lab. Engineering applications in fields including energy, transport, space and health benefit from the combination of the advanced design and manufacturing technologies available and from the expert advice of Lab's members.

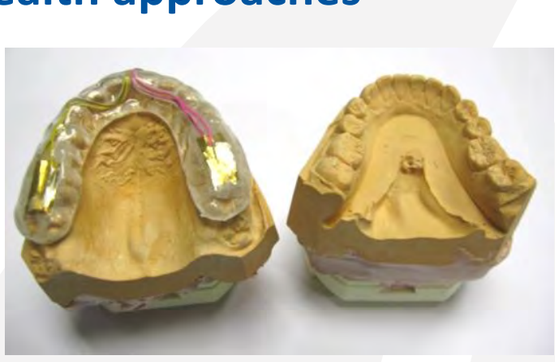
Among the most interesting engineering fields, to which the Lab has been devoted during the last decade, it is important to highlight the Biomedical Engineering area. As human geometries are complex and as human materials are "intelligent" or multifunctional, additive manufacturing technologies capable of manufacturing very complex geometries are specially well suited to manufacturing devices for interacting with humans. The design, modeling and incorporation of "smart", "intelligent" or multifunctional materials to such devices helps to enhance the diagnostic and therapeutic capabilities of such biomedical devices. In addition, the design using complex fractal-based geometries helps to promote biomimicry and biomimetic approaches towards improved performance. This poster presents some of the more remarkable patents of our group in the field of Biomedical Engineering, linked to biomedical devices for improved diagnoses and enhanced therapies, which take benefit from the combined use of bioinspired geometries and of smart materials and structures.

Diagnostic devices based on intelligent materials for improved diagnoses

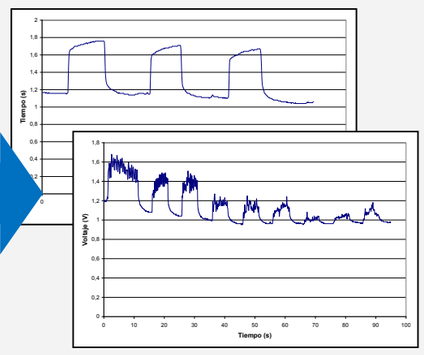
Complete development of an instrumented splint for monitoring bruxism based on piezoelectric & piezoresistive smart materials with near field communication for e-Health approaches

Bruxism is a pathology consisting of the involuntary clenching of teeth, with impact on facial pain and increased teeth wear. Adequately monitoring bruxism constitutes a challenges towards improved control of patients' evolution. Our device is based on smart sensors included within conventional splints for quantitative multi-axial measurements.

Patent: ***"Sistema de telemetría mediante comunicación inalámbrica empleando campo magnético sensor-pasivo / interrogador-activo para diagnóstico y detección de episodios bruxistas".*** *31 de Marzo de 2009. Número de Solicitud OEPM P200900875.* ***Concedida con examen previo el 15 de Febrero de 2010.***



Prototypes of instrumented splints for monitoring bruxism



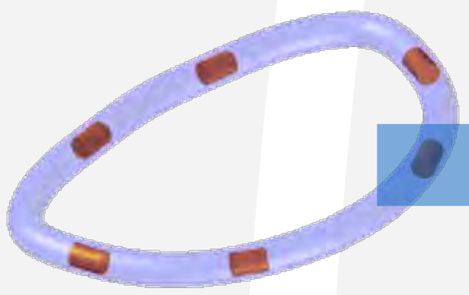
In vivo trials and results from measuring bruxist episodes

Active prostheses based on shape-memory materials for adaptative purposes

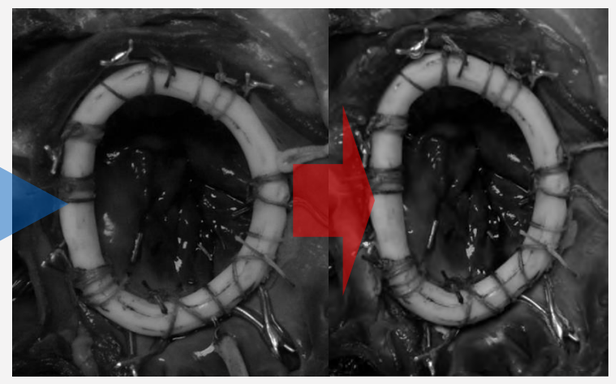
Complete development of an annuloplasty ring using shape-memory polymers for geometrical adjustment after implantation towards enhanced surgical prognosis

Mitral valve insufficiency can be treated with the help of passive annuloplasty rings, which provide mechanical support to the prolapsed tissue. However, surgery with conventional passive rings can be risky and devices for post-surgical adjustment of rings' geometries are a key towards improved prognosis. Our device pursues such challenge.

Patent: ***"Sistema de anuloplastia activo para el tratamiento progresivo de insuficiencias valvulares y otras patologías cardiovasculares".*** *13 de Diciembre de 2006. Número de Solicitud OEPM P200603149.* ***Concedida con examen previo el 16 de Mayo de 2008.***



Computer-aided design of shape-memory annuloplasty ring



Prototypes and *in vitro* trials of the shape-memory effect

Bioinspired tissue engineering scaffolds and culture platforms for studying cells

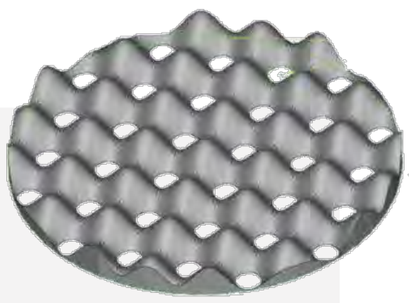
Fractal-based micro-textured and micro-structured

Based on biomimetic fractal geometries, which cannot be obtained using traditional design and manufacturing approaches, our tissue engineering scaffolds and cell culture platforms can activate special respones, helping to control mesenchymal stem cells' fate.

Patents:

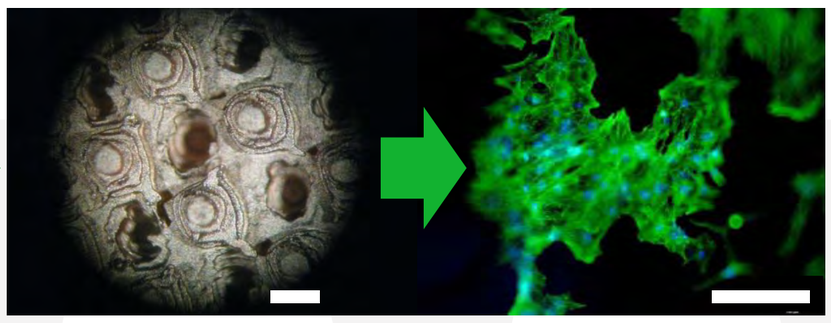
"Substrato cuasibidimensional para crecimiento de células y tejidos y método de obtención del mismo". *20 de Junio de 2010. Número de Solicitud OEPM P201030957.* ***Concedida con examen previo el 27 de Julio de 2012****. (UPM-CSIC).*

"Soporte tridimensional sintético de apoyo a tareas de producción artificial de órganos y otras estructuras del organismo humano y método de obtención del mismo". *20 de Junio de 2010. Número de Solicitud OEPM P201030956.* ***Concedida con examen previo el 16 de Junio de 2011.*** *(UPM-CSIC).*



Scaffold design obtained with help of CAD software

Scale bar: 500 microns



Rapid prototype for cell culture manufactured, directly from CAD file, in an additive way

Cell culture upon rapid prototyped scaffold for subsequent *in vitro / in vivo* studies

FEEDING CARRIAGE FOR COMPRESSOR MACHINE AND USE OF SAME

[a]Ordieres, J. , [b]Alba-Elías F., [b]González Marcos A., [b]Martínez L.

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Abstract

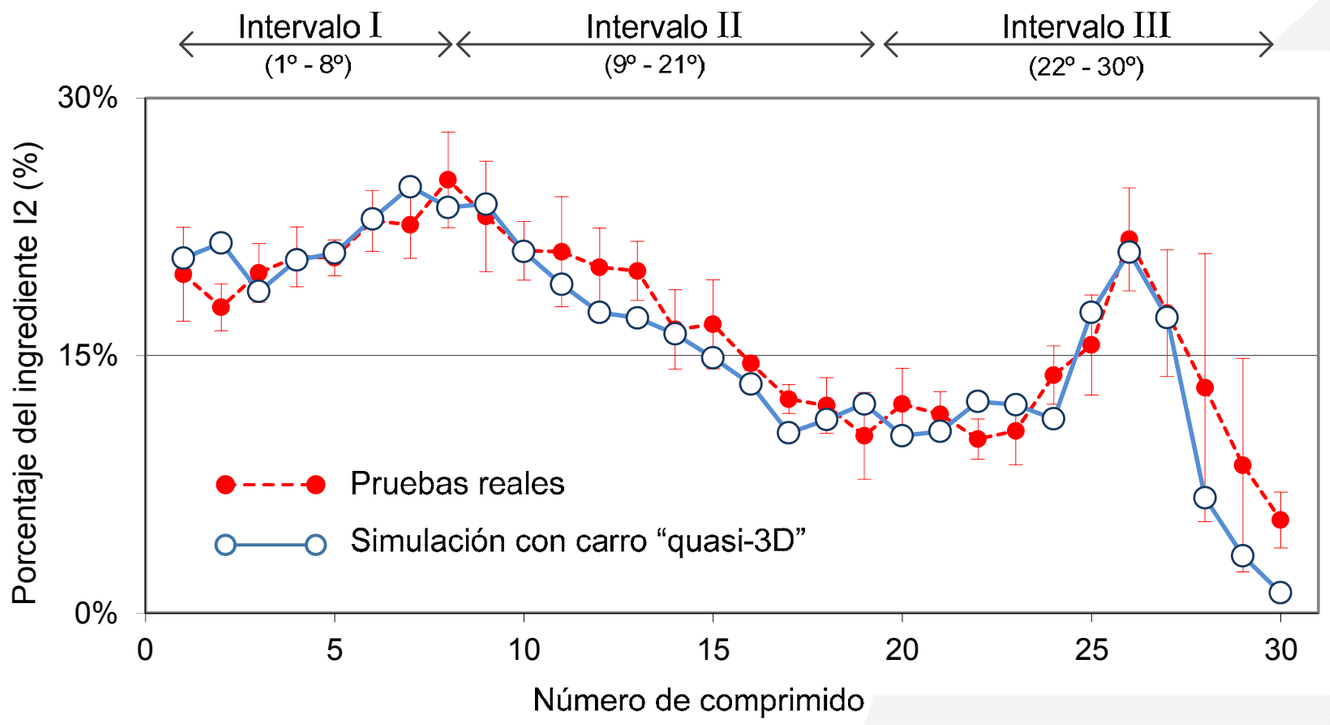
The invention describes a tractor truck for tableting machine, of the type having an upper filling end by which a particulate material for compressed in a matrix of the compression machine and a lower discharge end of said particulate material to said matrix is introduced . At least part of the constituent elements of said carriage feeder can move relative to one another, thereby allowing to modify the geometry of at least one of said lower discharge end, said upper filling end and an intermediate portion of the carriage feeder between both ends . The invention also discloses the use of a tractor truck of this type, comprising the initial steps of determining the optimum geometry for a particulate carriage to be compressed and to apply this optimum geometry carriage to carriage feeder.

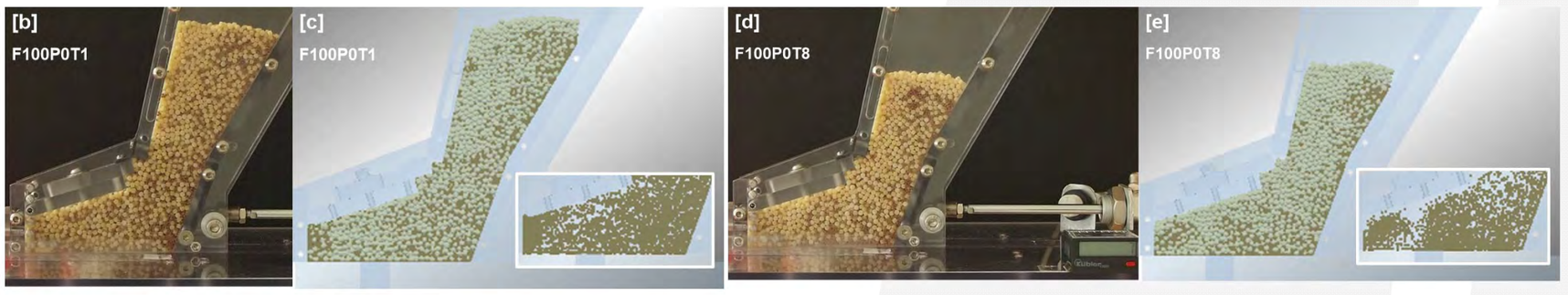
FEEDING CARRIAGE FOR COMPRESSOR MACHINE AND USE OF SAME

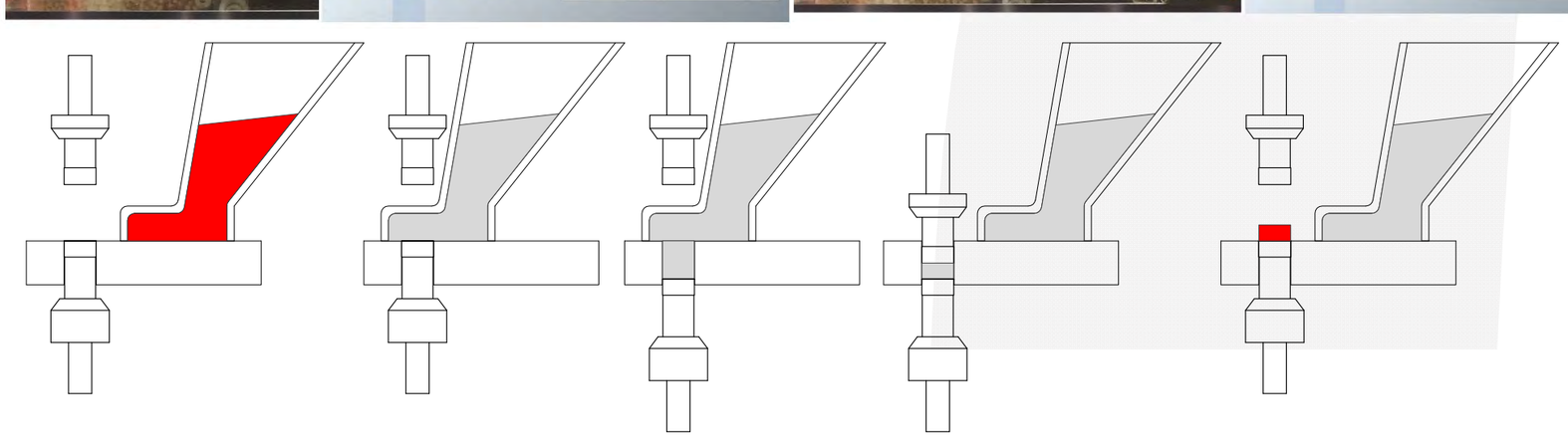
Publication number: 20160114549

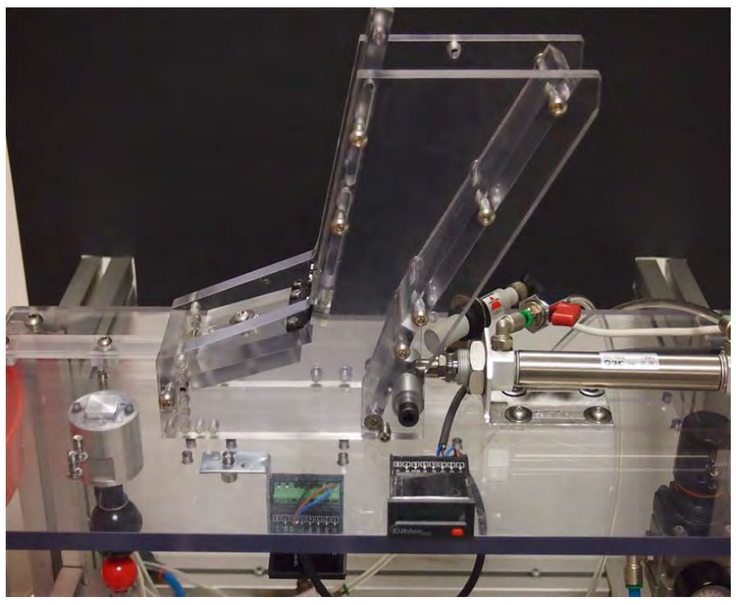
Focus

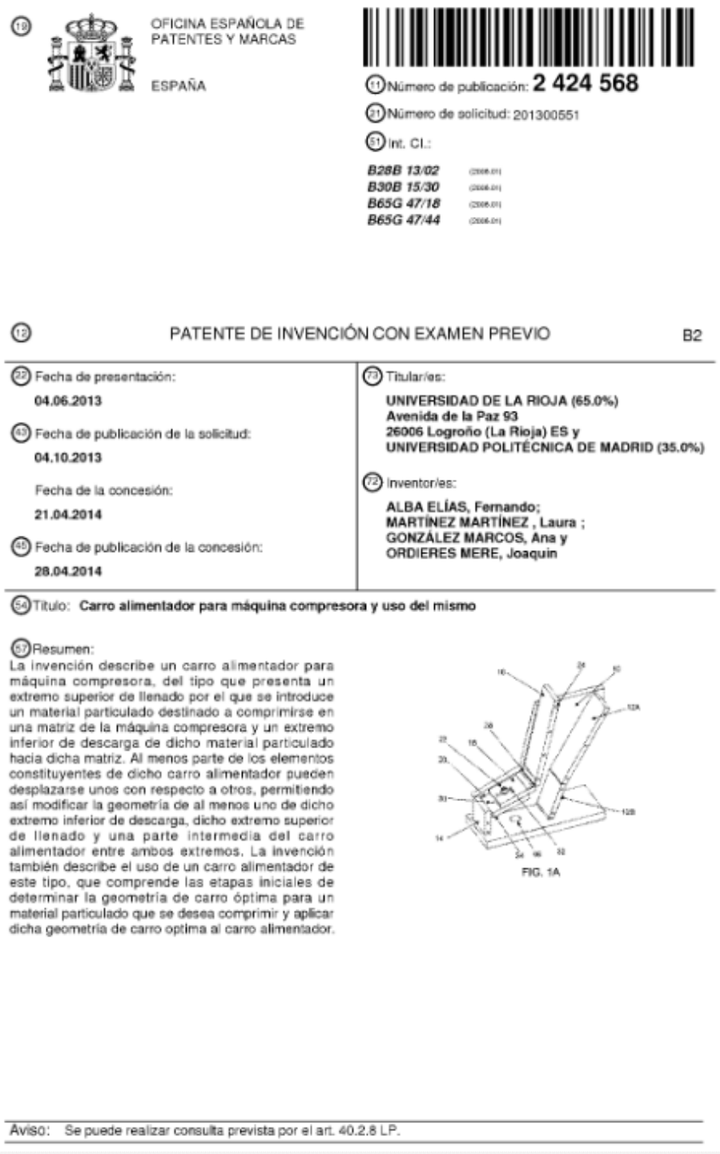
- To improve the effectiveness of dosage when mixture ratios are strict.
- To develop a method making possible to estimate the best geometry for the feeding carriage.
- To extend the patent to Japan and USA (triadic patent).











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ESPAÑA

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B65G 47/18 (2006.01)
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ORDIERES MERE, Joaquin

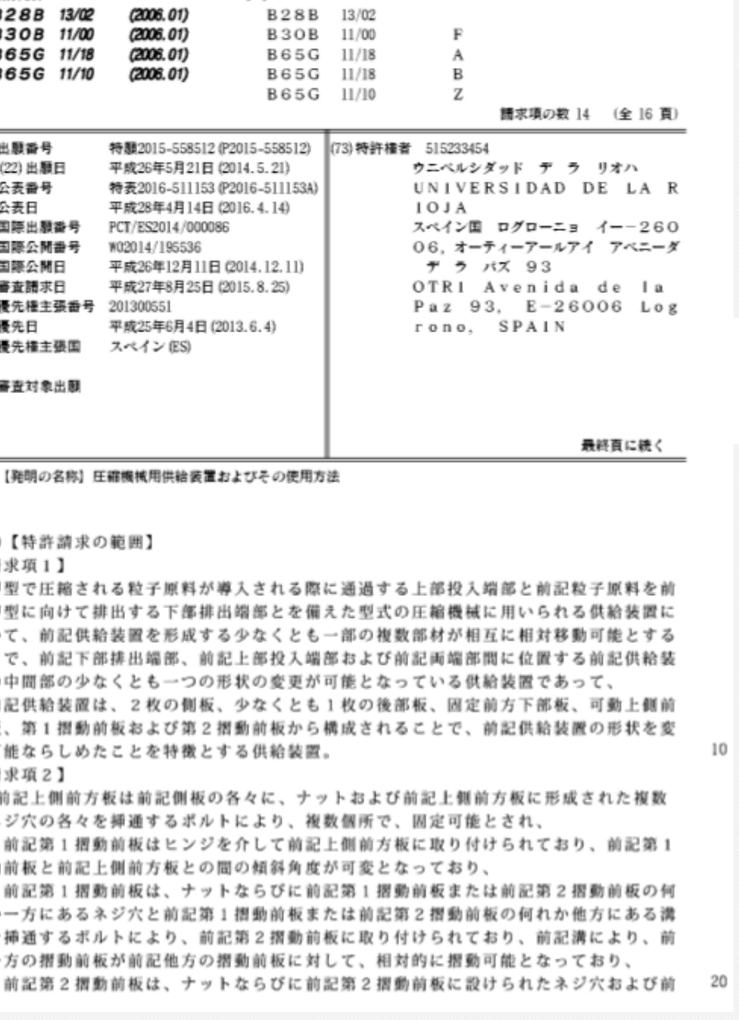
(54) Título: Carro alimentador para máquina compresora y uso del mismo

(57) Resumen:
La invención describe un carro alimentador para máquina compresora, del tipo que presenta un extremo superior de llenado por el que se introduce un material particulado destinado a comprimirse en una matriz de la máquina compresora y un extremo inferior de descarga de dicho material particulado hacia dicha matriz. Al menos parte de los elementos constituyentes de dicho carro alimentador pueden desplazarse unos con respecto a otros, permitiendo así modificar la geometría de al menos uno de dicho extremo inferior de descarga, dicho extremo superior de llenado y una parte intermedia del carro alimentador entre ambos extremos. La invención también describe el uso de un carro alimentador de este tipo, que comprende las etapas iniciales de determinar la geometría de carro óptima para un material particulado que se desea comprimir y aplicar dicha geometría de carro optima al carro alimentador.

FIG. 1A

ES 2 424 568 B2

Aviso: Se puede realizar consulta prevista por el art. 40.2.8 LP.



JP 5976962 B2 2016.8.24

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B30B 11/00	(2006.01)	B30B	11/00 F
B65G 11/18	(2006.01)	B65G	11/18 A
B65G 11/10	(2006.01)	B65G	11/18 B
		B65G	11/10 Z

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最終頁に続く

(54)【発明の名称】圧縮機械用供給装置およびその使用方法

(57)【特許請求の範囲】
【請求項１】
押型で圧縮される粒子原料が導入される際に通過する上部投入端部と前記粒子原料を前記押型に向けて排出する下部排出端部とを備えた型式の圧縮機械に用いられる供給装置において、前記供給装置を形成する少なくとも一部の複数部材が相互に相対移動可能とすることで、前記下部排出端部、前記上部投入端部および前記両端部間に位置する前記供給装置の中間部の少なくとも一つの形状の変更が可能となっている供給装置であって、
前記供給装置は、２枚の側板、少なくとも１枚の後部板、固定前方下部板、可動上側前方板、第１摺動前板および第２摺動前板から構成されることで、前記供給装置の形状を変更可能ならしめたことを特徴とする供給装置。
【請求項２】
－ 前記上側前方板は前記側板の各々に、ナットおよび前記上側前方板に形成された複数のネジ穴の各々を挿通するボルトにより、複数個所で、固定可能とされ、
－ 前記第１摺動前板はヒンジを介して前記上側前方板に取り付けられており、前記第１摺動前板と前記上側前方板との間の傾斜角度が可変となっており、
－ 前記第１摺動前板は、ナットならびに前記第１摺動前板または前記第２摺動前板の何れか一方にあるネジ穴と前記第１摺動前板または前記第２摺動前板の何れか他方にある溝とを挿通するボルトにより、前記第２摺動前板に取り付けられており、前記溝により、前記一方の摺動前板が前記他方の摺動前板に対して、相対的に摺動可能となっており、
－ 前記第２摺動前板は、ナットならびに前記第２摺動前板に設けられたネジ穴および前

Method for Increasing the Net Electric Power of Solar Thermal Power Plants

[a]Carlos A. Platero, [a]Francisco Blázquez, [a]Marta Redondo & [a]Jaime Rodríguez.

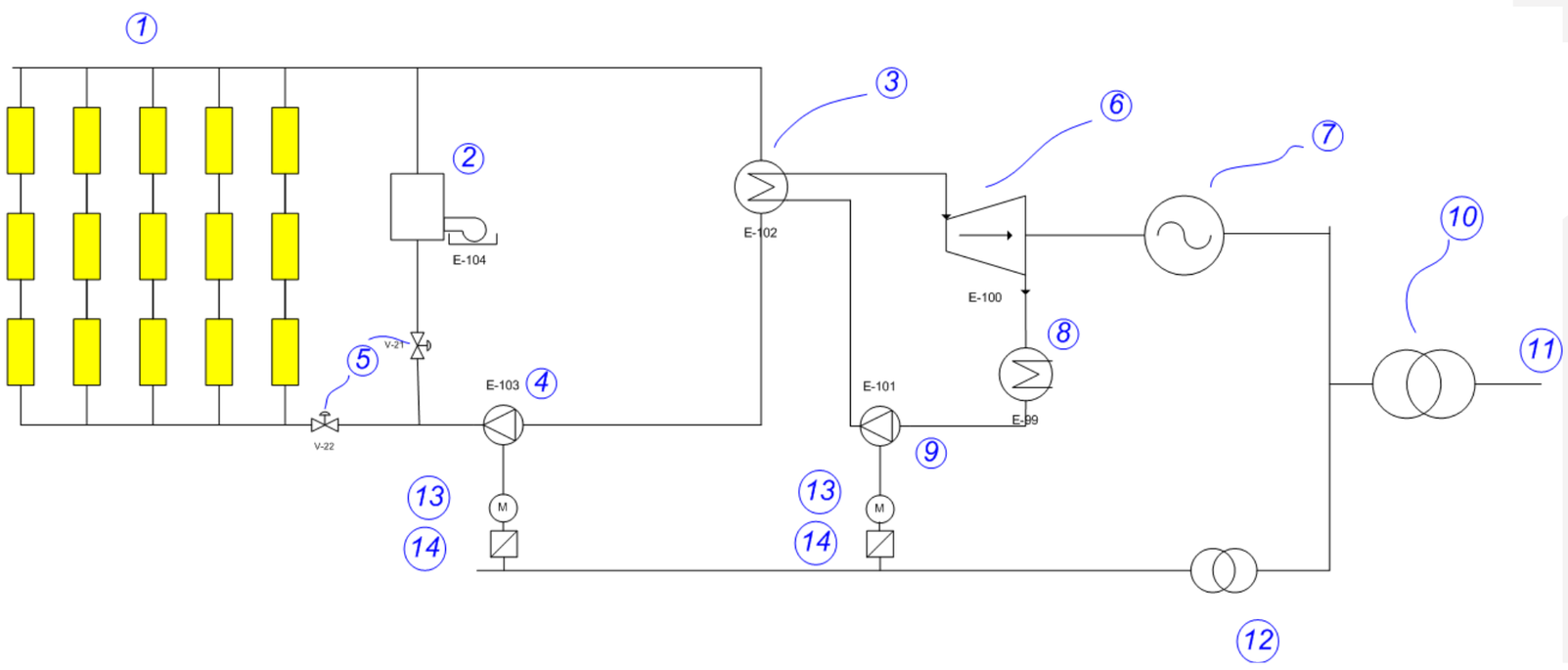
[a]Technical University of Madrid / ETSII /GELEO (carlosantonio.platero@upm.es)

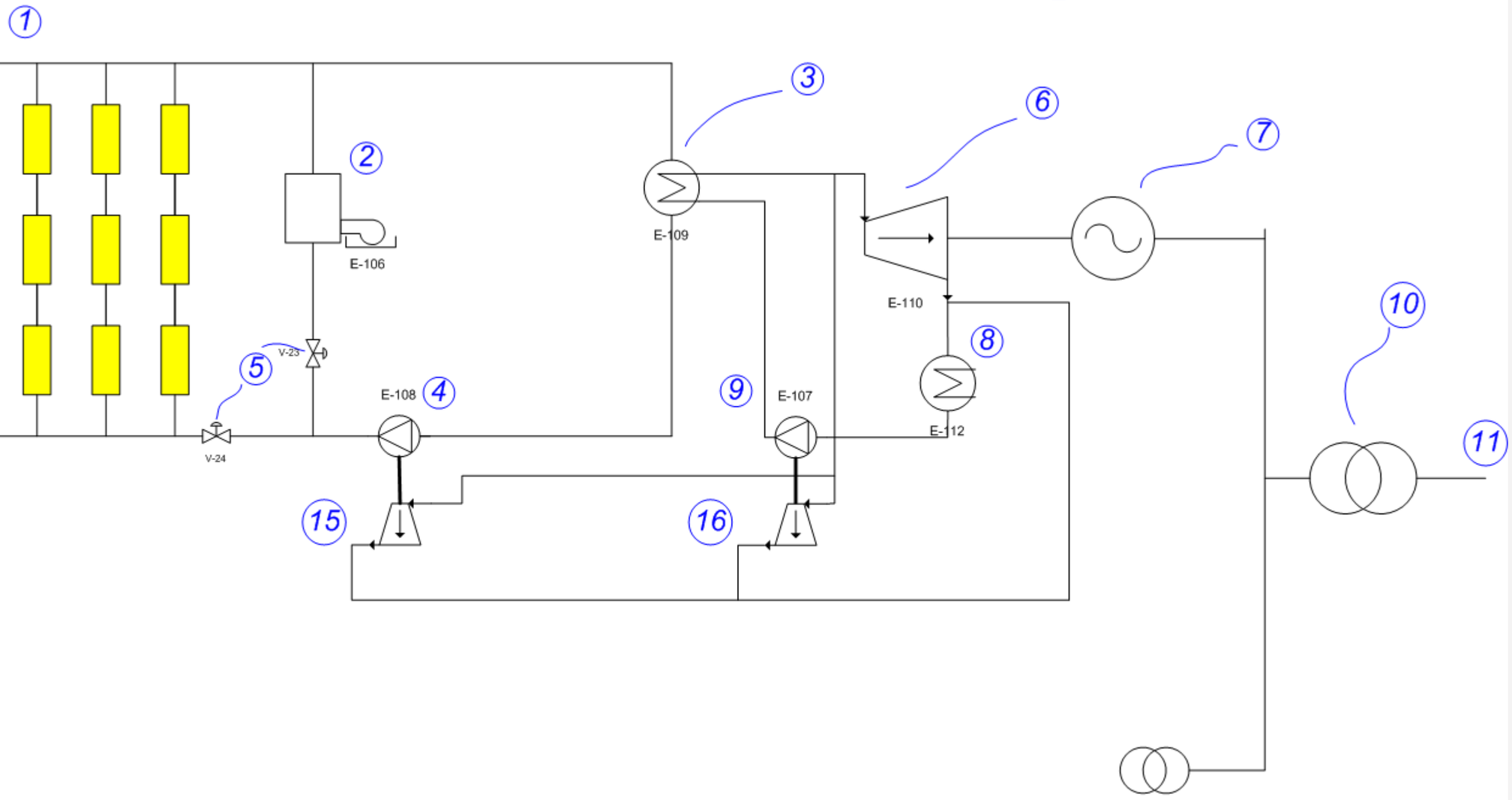
Abstract

The present invention allows increasing the net electric power supplied to the network by the solar thermal power plants of the cylindrical parabolic collector type by using the solar field in a more efficient manner, generating steam to drive the main ancillaries by means of steam turbines (turbo pumps), reducing electric consumption of the ancillary services and therefore increasing the net electric power of the plant.

On days when the solar radiation is greater than the designed radiation, part of the solar field must stop being used since the generator and the turbine would exceed its designated power. The present system proposes harnessing the unused portion of the solar field for generating steam to drive the main ancillaries of the plant, energy which would otherwise not be harnessed.

In addition, the overall operating performance of the ancillary service pumps is better when using steam to drive the pumps through a steam turbine (turbo pumps) instead of driving them with electric motors (motor pumps).





(1) Solar collectors	(2) Auxiliary burner of natural gas or another fuel.
(3) Steam generator. Thermo fluid heat and steam exchanger.	(4) Thermo fluid pump.
(5) Thermo fluid regulating valves.	(6) Main steam turbine
(7) Electric generator	(8) Condenser.
(9) Water supply pump supplying water to the steam generator.	(10) Main transformer
(11) Electric network	(12) Ancillary service transformer
(15) Steam turbine to drive the thermo fluid pump	(16) Steam turbine to drive the water supply pump supplying water to the steam generator

Country	Date	Application Number
Spain	16/04/2009	P200901000
Algeria	16/09/2011	EP10743430.0.
Australia	01/08/2011	5862/DELNP/2011
Brazil	08/08/2011	
Chile	12/08/2011	
China	17/08/2011	13/201,971
Egypt	18/08/2011	020110086502.
United Arab Emirates	18/08/2011	
USA		
EPO	18/08/2011	10-2011-7019197.
India		
Israel		
Libya		
Morocco		
Mexico		
OAPI		
South Africa	05/10/2011	2011/07281
Tunisia	07/10/2011	TN2011/0505

INDUSTRIALES RESEARCH MEETING 17

European Research & Innovation Office

Vice Rectorate for Research, Innovation and Doctoral Studies
Roberto Martínez (roberto.martinez@upm.es)
Ana Belén Bermejo (anabelen.bermejo@upm.es)

POLITÉCNICA

Abstract

The European Research & Innovation Office at UPM aims at giving support to UPM researchers to participate in the European research programs in order to increase the quantity and quality of European funded projects in which UPM participates.

The goal to be achieved by the European Office can be described as follows:

- to increase the weight of UPM participation in EU funded projects in terms of projects coordination.
- to facilitate first participations of newcomer researchers.
- to facilitate the collaboration of UPM researchers with the private sector.
- to increase the visibility of UPM at European Associations and Technology Platforms.

Services provided

For UPM researchers

Pre-award

- **POSITIONING** — Participation in European fairs, seminars and networking days, representing the UPM research community on international Associations and Technology Platforms.
- **PROPOSALS PREPARATION** — Support to the UPM researchers in their proposal preparation phase (completing consortia, revising the proposals, pre-checking with EC and NCPs the proposal ideas, etc.).
- **TRAINING** — Organization of H2020 information seminars, Post-doctorate course for European Project Managers, information and advice to interested researchers.
- **COLLABORATION SCOUTING** — Contact with relevant European projects participants to look for collaboration opportunities.

Post-award

- **COST REPORTING**
- **CONTRACT PREPARATION** — Contract negotiation and forms filling; IPR issues; Consortium Agreements; Cost claims and audits; Relation with the EU
- **TRAINING**
- **AUDITING**

For other organizations

It represents a single point of contact for partners searching for a specific technological capacity within the University.

Networks

eit Digital · eit Health · eit RawMaterials

Vision 2020

OTRI - Unidad de Cátedras Universidad-Empresa

Ana Goicolea, Lidia Cerezo y Miguel Holgado

Unidad de Cátedras Universidad-Empresa
OTRI – Vicerrectorado de Investigación, Innovación y Doctorado
otri.investigacion@upm.es

Abstract

El objetivo de la **Unidad de Cátedras Universidad-Empresa de la OTRI** es promover la colaboración estable entre la Universidad y el tejido empresarial a través de un modelo concreto, las Cátedras.

¿Qué es una Cátedra Universidad-Empresa UPM?

Es un convenio que formaliza y hace pública la **colaboración a largo plazo** entre la **universidad** y una **empresa** para la realización de actividades diversas alineadas con los fines generales de la UPM en un área temática concreta.

¿Qué beneficios ofrece?

Beneficios para la empresa

- ✓ Acceso directo a los **recursos humanos** y a determinadas **infraestructuras** de la **Universidad**
- ✓ Apoyo a diferentes actuaciones dentro de ámbitos temáticos de su interés mediante:
  - **Programas de becas** para la realización de proyectos fin de grado o de máster
  - **Trabajos de investigación**
  - Promoción de **jornadas de divulgación**

Beneficios para la Universidad

- ✓ Relación con **empresas de primer nivel**
- ✓ Marco de **financiación estable** para la realización de actividades:
  - Cooperación en programas de **formación**
  - Patrocinio de actividades de **difusión**
  - Realización de **estudios e investigaciones**
  - Otras actividades enmarcadas en los objetivos planteados

¿Qué actividades realizan?

ACTIVIDADES DE FORMACIÓN

Programas de postgrado, becas, premios a proyectos fin de carrera, conferencias…

ACTIVIDADES DE DIFUSIÓN

Jornadas de divulgación técnica y tecnológica, publicaciones…

ACTIVIDADES DE I+D

Promoción de líneas de investigación, apoyo a la realización de tesis doctorales…

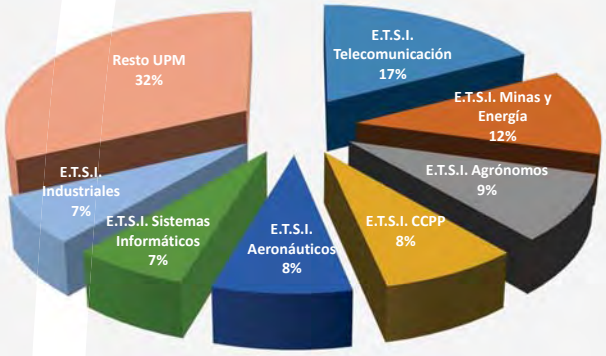
¿Qué duración tienen?

La duración mínima de una Cátedra es de **3 años.**

¿Cuál es la financiación mínima?

Se establece un mínimo de **30.000 € anuales**.

Cátedras UPM por centros



Fuente: UPM. Datos a marzo de 2017.

+ 70 Cátedras Universidad-Empresa en la UPM

Cátedras Universidad-Empresa en la ETSI Industriales

ALSTOM · Fundación REPSOL · CSN Consejo de Seguridad Nuclear · CESEDEN Centro Superior de Estudios de la Defensa Nacional · elecnor

¿Dónde debo dirigirme?

Unidad de Cátedras Universidad Empresa
www.upm.es/CatedrasUniversidad-Empresa
otri.investigacion@upm.es

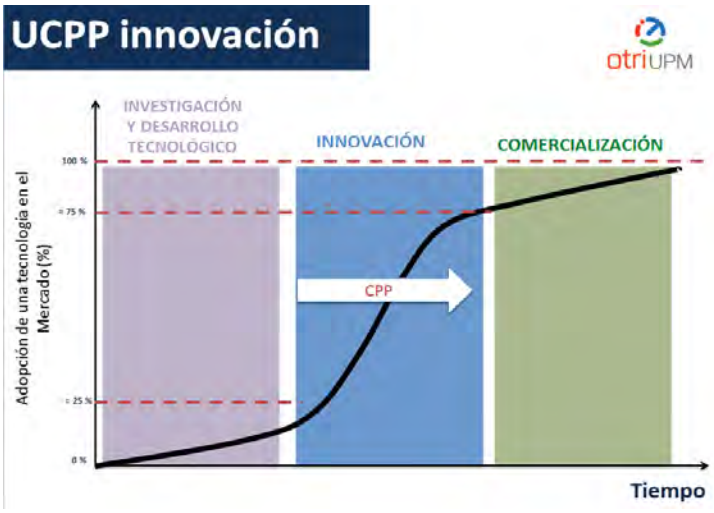
OTRI- Unidad de Colaboración Público–Privada (UCPP)

Juan Sanz, Norma García y Miguel Holgado

Unidad de Colaboración Público-Privada
OTRI – Vicerrectorado de Investigación, Innovación y Doctorado
juan.sanz@upm.es

Abstract

La **Unidad de Colaboración Público Privada de la OTRI** nace con el objetivo de servir de instrumento de dinamización, apoyo y promoción de la transferencia del conocimiento generado en la UPM al sector productivo.



La Unidad de Colaboración Público–Privada centra su actividad en el ámbito de la INNOVACIÓN.

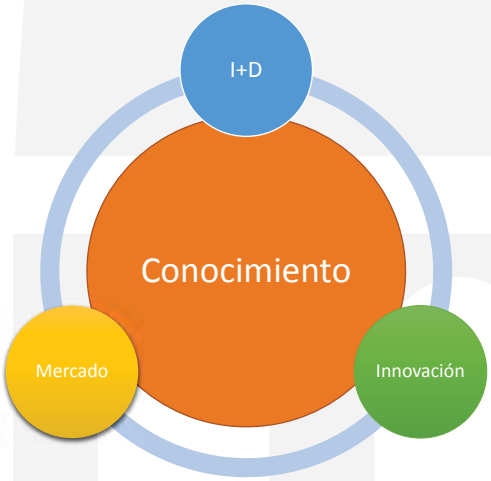
Entre la Investigación y el Desarrollo Tecnológico generado por la UPM y su introducción en el mercado a través de los instrumentos de Comercialización, existe un escalón intermedio en el cual la intervención de esta Unidad puede facilitar un incremento de llegada de nuestra producción científica y tecnológica al mercado.

¿Qué servicios presta?

- **Gestión directa de convocatorias de ayudas a la Innovación,** difusión, apoyo a la presentación de propuestas, tramitación de solicitudes, alta de los proyectos concedidos, seguimiento de proyectos activos, apoyo en la justificación de las ayudas.
- **Asesoramiento** en la negociación, elaboración y tramitación administrativa de contratos, convenios y otros acuerdos relacionados con actividades de investigación e innovación.
- **Promoción** a través de la búsqueda de financiación para el desarrollo de proyectos de I+D+i en colaboración con empresas y otros agentes, así como la difusión de convocatorias públicas y privadas de ayudas a la I+D+i.
- **Formación** de investigadores en los procesos de búsqueda de financiación, presentación de propuestas, gestión y justificación de ayudas públicas.
- **Documentación,** elaboración modelos de Contratos / Convenios / Acuerdos / documentación administrativa.

Nuestra Visión

Ser un instrumento útil para el impulso del Triángulo del Conocimiento, facilitando la colaboración entre la Universidad y la Empresa en la generación de conocimiento, en su desarrollo y en la innovación, que permita introducir en el mercado nuevos productos y servicios generando riqueza y bienestar en nuestra sociedad.



¿Dónde debo dirigirme?

Unidad de Colaboración Público –Privada
http://www.upm.es/Investigacion/Apoyo/OTRI
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OTRI - Unidad de Propiedad Industrial e Intelectual

Norma García, Ana Goicolea, Dolores Martínez y Miguel Holgado

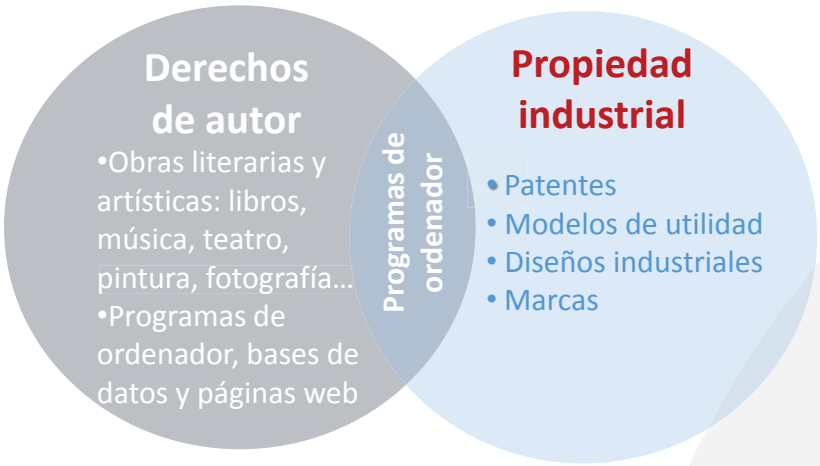
Unidad de Propiedad Industrial e Intelectual
OTRI – Vicerrectorado de Investigación, Innovación y Doctorado
otri.investigacion@upm.es

Abstract

El objetivo de la **Unidad de Propiedad Industrial e Intelectual de la OTRI** es proteger los resultados de la investigación que tengan una componente técnica utilizando los mecanismos adecuados con el fin de tener tecnologías listas para ser transferidas.

¿Qué es la propiedad intelectual (PI)?

Es un concepto legal para **proteger las creaciones de la mente humana** que otorga el derecho a su titular a impedir a terceros la utilización sin su consentimiento. Se divide en dos categorías:



¿Por qué son importantes las patentes para los investigadores?

• Porque es una **valiosa fuente de información** que permite: comprobar si una invención es novedosa, evitar infringir los derechos de terceros, conocer la tecnología existente y utilizarla como base para la investigación.

•Porque permite **proteger los resultados** de la investigación y **rentabilizarlos** mediante la explotación propia (creación de una spin-off) o licencia a terceros

¿Qué debo hacer cuando creo tener una invención patentable?

- **Evitar la divulgación** antes de la solicitud de patente que anule la novedad: conferencias, congresos, tesis, trabajos fin de carrera, artículos, etc.
- **Buscar el estado de la técnica anterior**
- Buscar **asesoramiento en la OTRI**

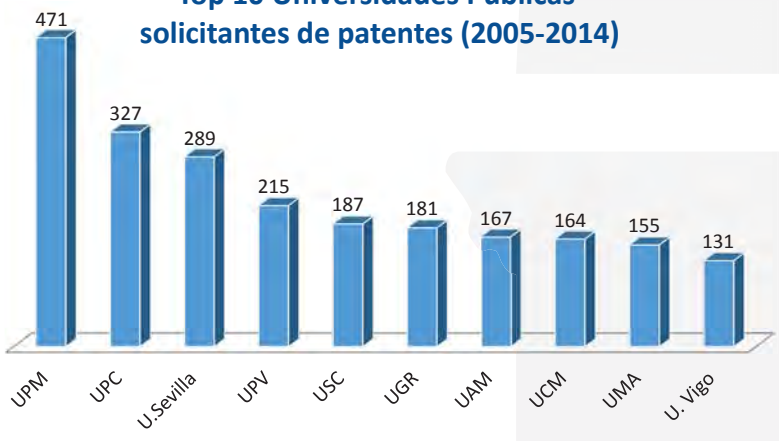
¿Puedo patentar un programa de ordenador?

- Un programa de ordenador reivindicado como tal no es una invención patentable. En cambio, sí pueden concederse patentes para **invenciones implementadas en ordenador** que resuelvan un problema técnico de forma inventiva.

- El código fuente y el ejecutable del programa son objeto de **derechos de autor** y pueden inscribirse en el Registro de la Propiedad Intelectual.

La PI de la UPM en cifras

Top 10 Universidades Públicas solicitantes de patentes (2005-2014)

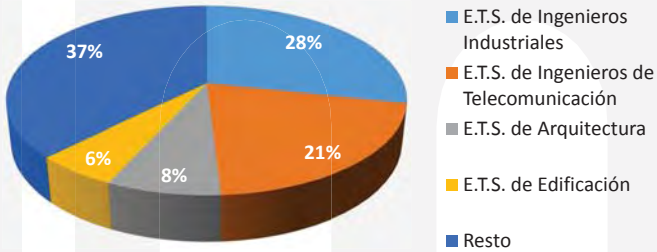


Fuente: OEPM

+ 520 patentes prioritarias activas

+ 190 programas de ordenador registrados

Solicitudes de patentes UPM por Centros



Fuente: UPM. Datos a marzo de 2017.

INDUSTRIALES RESEARCH MEETING 17

OTRI - Unidad de Cultura Científica UPM

Pilar Fernández, Carmen Matías, Rocío Oña y Miguel Holgado

Unidad de Cultura Científica (UCC)
OTRI-Vicerrectorado de Investigación, Innovación y Doctorado
cienciaysociedad@upm.es

Abstract

En la **Unidad de Cultura Científica** (UCC) trabajamos para difundir la investigación UPM a la sociedad. Nuestro objetivo es acercar la ciencia, la tecnología y el trabajo de los investigadores a la ciudadanía para, entre otras cosas, incrementar su impacto.

Comunicación: elaboración de noticias, audiovisuales, fichas divulgativas... sobre investigación UPM.

Divulgación: organización de eventos de ciencia con interacción directa entre investigadores y público.

Semana de la Ciencia
(15 días, 150 actividades,
+ 5000 participantes)

Ferias de Ciencia
(2 días, 10 actividades,
+ 10000 participantes)

Foros de participación
(1 día, 4 mesas redondas,
+ 500 participantes)

Noche de los Investigadores
(1/2 día, 10 actividades,
+ 1000 participantes)

Investigación y promoción: organización de cursos, convocatoria de premios y proyectos de divulgación científica.

En la UCC os ayudamos a difundir vuestra investigación

Unidad de Cultura Científica
www.upm.es/ucc
cienciaysociedad@upm.es

INDUSTRIALES RESEARCH MEETING 17

ación del

INSIA

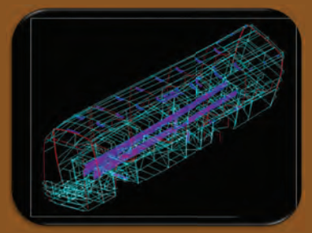
POLITÉCNICA

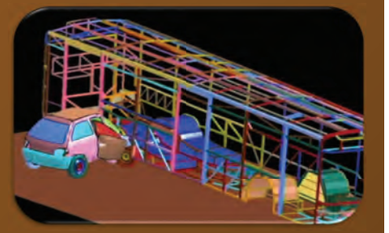
INSIA-UPM: INSIA, the University Institute of Automobile Research is a Centre belonging to Technical University of Madrid (UPM), part of the Higher School of Industrial Engineers, and is integrated into the UPM's scientific and technological park. The INSIA is a reference point for the automotive industry and the transport sector and has over 25 years of experience at national and international levels. The main activities of the Institute are focused on **Research and Development in the field of motor vehicles, safety and environmental impact for national and international projects**. INSIA also **offers technological support for companies and public bodies**. INSIA provides technological services oriented to R+D, advising, testing, and certification. The Institute also runs Masters degree and Ph.d degree programs.

Research Areas

Accidentology

Biomechanics



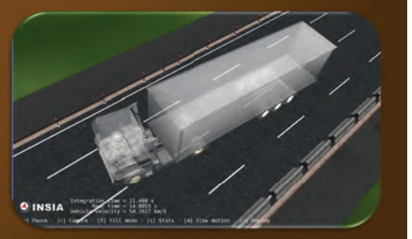


Passenger and goods Transports Safety

Alternative propulsion systems

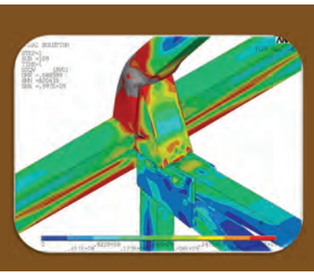
ADAS

Transport Studies

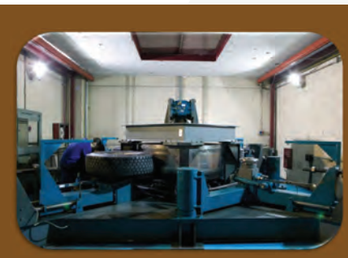


Computational Mechanics

Technology Services



R+D+i Applied to Vehicles Systems and Components: Structural Design. Passive Safety. Engine test bench. Pollutant emissions laboratory. Hybrid and electric Vehicles.



Technical Service authorized by the Ministry of Industry for the design of homologation tests for some international regulations and directives (Automotive Industry. Motor Vehicle Directives and Regulations.)

Training

Our goal is to satisfy the training needs of managerial staff in companies in the Automobile Sector, the needs of new graduates aspiring to work in sector companies and the needs of employees and researchers in the INSIA itself. Master´s in Automotive Engineering, Master´s in Hybrid and Electric Vehicle Engineering, Master's Degree in Energy Efficiency in Building, Industry and Transportation, Formula Student, Specialised Courses.

INDUSTRIALES RESEARCH MEETING 17

ansportes

INSIA

POLITÉCNICA

GIVET

GIVET group is made up of 70 people including researchers, technical staff, management staff and research personnel in training, who have been working for 25 years in R+D+i activities related to the traffic accidents and vehicles safety, automobile industry, transportation sector and more recently to the transportation environmental impact.. An important part of our research staff is mainly affiliated with ETSI Industriales and INSIA. We develop our activities in INSIA-UPM, a reference center for the automotive industry and the transport sector at national and European level. The research staff represents Spain at the United Nations in various working groups and is integrated in several European networks of excellence such as ECTRI (European Conference of Transport Research Institutes). At the national level, it is part of the M2F platform (Move to Future) and Madrid Automotive Cluster.

Research Areas

Accidentology

Traffic Accidents Investigation. Analysis of Causes and Consequences.

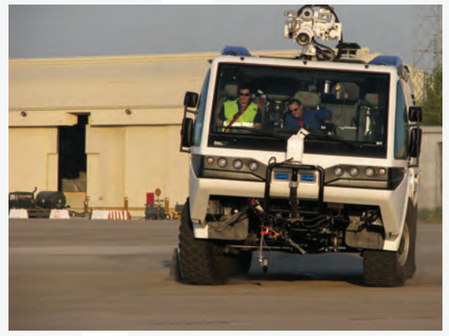
Biomechanics

Impact biomechanics applied to the improvement of passive safety of vehicles.

Passenger Transports Safety

Passenger transports safety. Vehicles occupant protection systems and mobility of PRMS

Goods Transports Passive Safety



Goods Transports Passive Safety Improvement. Vehicles and Protection Systems

Transport Studies

Assessing and predicting the impact of road transport on safety and environment.

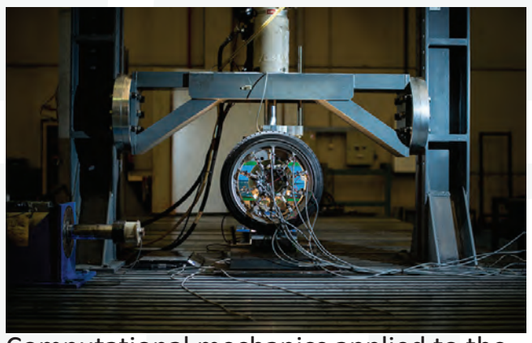
ADAS

Intelligent Transport Systems and Driver Assistance Systems

Alternative propulsion systems

Alternative propulsion systems and environmental impact of motor vehicles.

Computational Mechanics



Computational mechanics applied to the research of the dynamic behavior of vehicles

INDUSTRIALES RESEARCH MEETING 17

http://www.denim.upm.es

cial y Tecnología de

STEELS IRRADIATION DAMAGE AND TRITIUM DIFFUSION

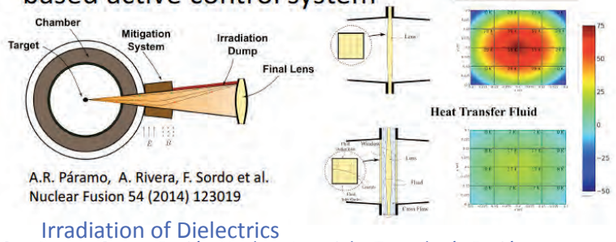
IFN Instituto de Fusión Nuclear

UNIVERSIDAD POLITÉCNICA MADRID — POLITÉCNICA

The Instituto de Fusión Nuclear was founded in 1981 as a Research Institute Advisor of Government in Nuclear Affairs. Actually, it is an official Research Institute of the Universidad Politecnica de Madrid, with Partners within the Universidad Nacional Educación a Distancia (UNED) and Universidad de Las Palmas de Gran Canaria (ULPGC).
25 Professor, 3 Post-Doc under contracts or associated from other institutions, 15 PhD Students, and more Master or Degree Thesis.
Considered the first European civil laboratory to publish at the end of 70´s on coupled simulation models for Nuclear-Radiation-Hydro mechanisms in High Energy Density Physics, it is presently recognized as the leading Institution in Materials, Neutronics and Activation Technologies in Inertial Fusion Energy using lasers or ions.
Main research is conducted for Inertial Fusion Energy, Physics for Fusion Technology. Other key areas are: X-rays lasers and Astrophysics; Atomic Physics; Experiments and Simulation of Nanomaterials under irradiation; Advanced Optics; Nuclear Defense&Non-Proliferation and Security; Intense Neutron Sources in particular our collaboration with ESS-Bilbao for large ESS-Lund; Tritium; Neutronics and Activation; ITER design

Fusion plant components

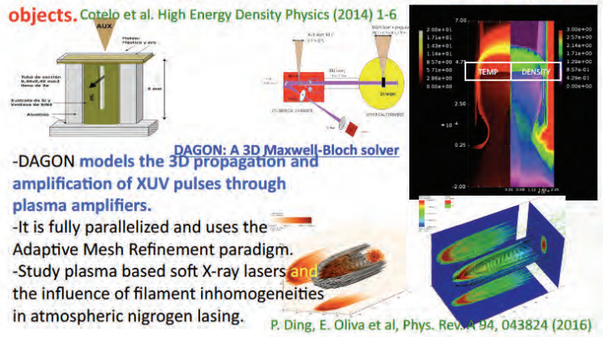
Example ICF chamber and lens systems:
To keep temperature uniformity on lenses (origin of aberrations), we designed a fluid-based active control system



A.R. Páramo, A. Rivera, F. Sordo et al. Nuclear Fusion 54 (2014) 123019

Irradiation of Dielectrics
See Poster Grupo Fusión Nuclear Inercial y Tecnología Fusión

Reproducing Astrophysical phenomena at Laboratory scale. Laser irradiation produces strong Radiative Shock Waves bringing matter to High Energy Density states equivalent to astrophysical objects. Cotelo et al. High Energy Density Physics (2014) 1-6



DAGON: A 3D Maxwell-Bloch solver
-DAGON **models the 3D propagation and amplification of XUV pulses through plasma amplifiers.**
-It is fully parallelized and uses the Adaptive Mesh Refinement paradigm.
-Study plasma based soft X-ray lasers and the influence of filament inhomogeneities in atmospheric nigrogen lasing.

P. Ding, E. Oliva et al, Phys. Rev. A 94, 043824 (2016)

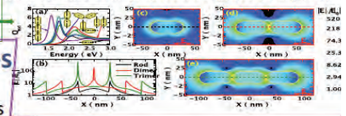
See also Poster Grupo Fusión Nuclear Inercial y Tecnología Fusión

Irradiation of NPs with fs lasers

See more clear views of these subjects in Poster Grupo: Fusión Nuclear Inercial y Tecnología de la Fusion

A light-controlled synthetic procedure allows obtaining selected plasmonic oligomers by irradiation with low fluence near-infrared femtosecond laser pulses. Optical extinction spectra, local field enhancement of single AuNRs, rod dimers and trimers

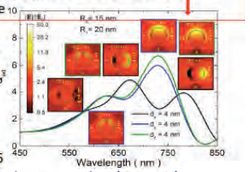
González-Rubio et al Nano Letters 15, 8282-8288 (2015)



Plasmonic Nanoparticles

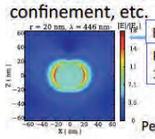
Fabrication by PLD of NPs and simulation of their optical properties by means of diverse methods (FDTD, Mie theory, T-Matrix) for applications like SERS, local heating, energy confinement, etc.

Extinction spectra and corresponding field enhancement of a gold NP with an eccentric dielectric core



Electric field enhancement of an Ag NP

Peña et al Opt. Mater. Express 4, 1943-1952 (2014)



Peña et al Nanoscale Res Lett. 2017; 12: 16

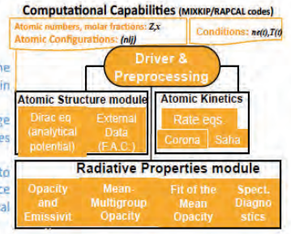
See also Poster Grupo Fusión Nuclear Inercial y Tecnología Fusión

The Atomic Physics Group at the Institute of Nuclear Fusion

The Atomic Physics Group has accumulated experience over the years in developing a collection of theoretical and computational models for determining the atomic structure, atomic kinetics, radiative properties and thermodynamic properties of a wide variety of high-energy-density plasmas (HEDP).
One of our strong points relies on the versatility of atomic kinetics and radiative properties calculations which can be carried out for local (LTE) and non-local thermodynamic equilibrium (NLTE) both mono and multi-component plasmas, time-dependent situations, optically thin/thick plasmas or under external radiation fields.

At present, the main research areas are:

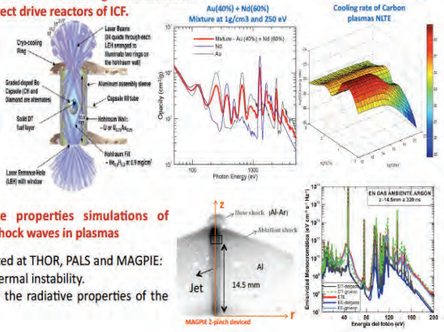
Advancing in the microscopic characterization of HEDP:
Inertial fusion, Magnetic fusion and Laboratory astrophysics.
Developing in computational modeling and simulation of the atomic kinetics and the radiative properties of ICF plasmas, in particular: Target and Hohlraum Fill and Wall.
Generation of radiative properties databases (average ionization, opacities/emissivities, mean/multigroup opacities and radiative power losses) both in LTE and NLTE.
Characterization of the hydrodynamic instabilities due to thermal cooling in the edged plasmas of magnetic fusion device and in the radiative shocks characteristic of astrophysical systems.



The Atomic Physics Group at the Institute of Nuclear Fusion

Radiative properties of mixture. Material design and Chamber gas-fill for Hohlraums at indirect drive reactors of ICF.

- Generation (MIXKIP/RAPCAL codes) and Parametrization (PARPRA code) of NLTE-plasma radiative properties (opacities and cooling rates) to analyze the absorption and emission properties of the characteristic elements (Au, Nd, C,...) in the ICF plasmas.

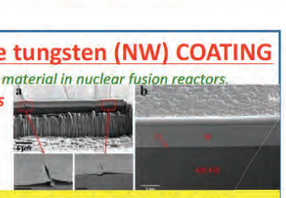


Atomic-kinetic and radiative properties simulations of supersonic jets and radiative shock waves in plasmas

- Radiative shock waves generated at THOR, PALS and MAGPIE:
  - Characterization of the thermal instability.
  - Important NLTE effects in the radiative properties of the Bow shock.

Adhesion of nanostructure tungsten (NW) COATING

Motivation: *W is proposed as plasma facing material in nuclear fusion reactors.*
The adhesion of W to the ***structural steels***
Aims:
Investigate the adhesion as a function of:
•Steel roughness for bare substrate
•Presence of a Cr interlayer.



Conclusions: M. Panizo, R. Gonzalez-Arrabal *et al.* submitted to Jour. of Nucl. Mat.
•For NW samples deposited onto bare steels: the lower the roughness the higher the adhesion.
•The Cr interlayer improves the adhesion and eliminates its dependence on the substrate roughness

Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and OKMC simulations of light species diffusion

(see more details in Poster Grupo: Fusión Nuclear Inercial y Tecnología de la Fusión & Oral of M. Panizo) G. Valles, *et al.* Acta Materialia122 (2017) 277e286

Motivation: *H and He tend to nucleate in defects resulting in cracking, exfoliation or blistering.*
Conclusion: H escapes through grain boundaries; more in Nanostructure W = KEY solutions

See also Poster Grupo Fusión Nuclear Inercial y Tecnología Fusión

NUCLEAR SECURITY AND DEFENSE

Nuclear non-proliferation. Scientific and technical (S&T) analysis of countries that have signed the Nuclear Non-Proliferation Treaty. North Korea: technical problems on its withdrawal from the NPT. Iran: scientific and technical vulnerabilities in relation to the Joint Comprehensive Plan of Action (JCPOA) signed with P5 + Germany and the EU.

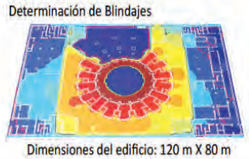
Antineutrino detection systems. Scientific and technical analysis of interaction of neutrinos with the matter.

Illicit trafficking of radioactive materials. Technical, radiological problems and scope of actions at global level.

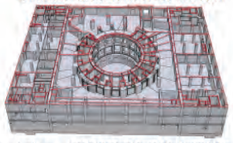
Security of the European Union. Strategic analysis of recognized threats.

Security against attacks of Radiological Dispersion Devices (dirty bombs). Proactive S&T study on prevention, detection, response and mitigation.

ITER (Reactor Experimental Fusión Magnética)
Mapas de radiación en ITER Tokamak Complex
- Compatibilidad de la electrónica
- Presencia de trabajadores
- Tareas de mantenimiento
- Determinación de Blindajes

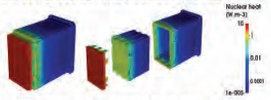


Dimensiones del edificio: 120 m X 80 m

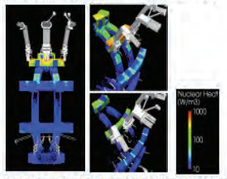


Presentado en el ITER CCB-221, ITER_D_SXRSHE_v1.4

Análisis nuclear de integración de diversos puertos de ITER:
- EP#16 con los European TBMs[1]
- EP#11 y EP#12 con first plasma diagnostics



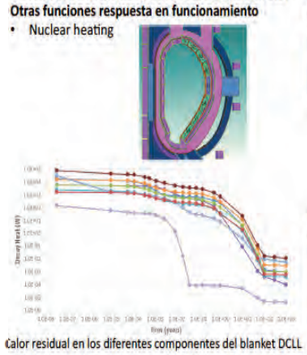
Determinación y mitigación del calentamiento de la bobinas superconductoras de ITER[2]



[1]Fus. Eng. & Des., Vol 109–111 (2016) 1554-1558 & [2]ITER_D_Q3VXKE

DEMO (Reactor Demostrador Fusión Magnética)
Caracterización en parada del blanket europeo DCLL:
- Activación (actividad , calor de decaimiento, etc)

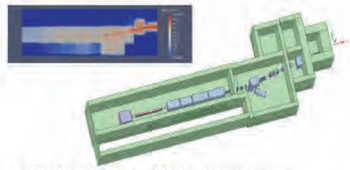
Otras funciones respuesta en funcionamiento
- Nuclear heating



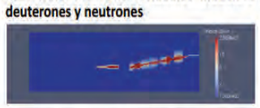
Calor residual en los diferentes componentes del blanket DCLL

Trabajo realizado en el marco de EUROFusion WPSAE
Tarea: SAE-2.17.1-T01-D08; 2017

ENS (Fuente de Neutrones para Fusión)
1. Cálculo del campo de fotones y neutrones generado en el acelerador en fase de funcionamiento



2. Cálculo de Dosis residuales inducidas por deuterones y neutrones

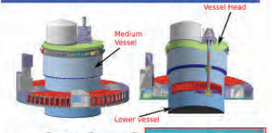


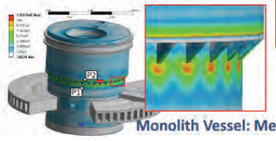
Trabajo realizado en el marco de EUROFusion WPENS
Presentado en WPENS Neutronics meeting 1 Febrero 2017
Tarea: ENS-2.2.2.2-T10-10 & ENS-2.2.3.2-T10-11

EUROPEAN SPALLATION SOURCE

Neutron sources and nuclear engineering: European Spallation Source
- INF is working on the design of nuclear components for the
- **European Spallation Source:** Target, Monolith Vessel, Proton Beam Window, Tunning Beam Dump ...
- The design of this components includes Neutronics, radiation damage Thermo-mechanical design and Safety.

ESS Monolith Vessel (Φ6 x 6 m)

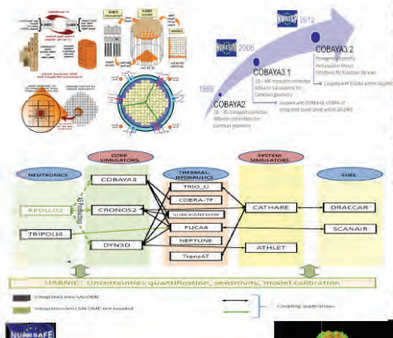




Monolith Vessel: Mechanical analysis

ESS: Spallation Target

GRUPO DE FISION NUCLEAR



Nuclear reactor safety simulation platform (Euratom)

Research lines
Computational analysis of advances nuclear fission systems.
Propulsion systems for naval and space applications.
Scientific methods for history and communication in nuclear energy.

SEANAP System development *(Sistema Español de Análisis de Núcleos de Agua a Presión) PWR Nuclear power plant simulations Ascó I, Ascó II, and Vandellós*

Grupo de Investigación en Ciencia y Tecnología de sistemas avanzados de fisión nuclear

Principal Researcher: carolina.ahnert@upm.es **http://www.din.upm.es**

Composition: 27 members

- ETSI Navales (2 Prof)
- ETSI Industriales (6 Prof., 8 PhD)
- ETSI Minas y Energía (1Prof., 10 PhD)

Teaching:

Master: "Nuclear Science and Technology", " Energy Engineering", and "Naval and Oceanic Engineering"

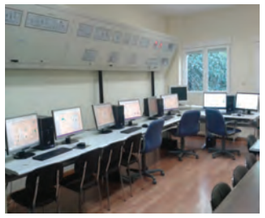
Doctorate "Sustainable Energy, Nuclear and renewable"

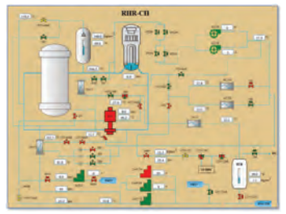
Research lines

- Computational analysis of advances nuclear fission systems
- Thermohydraulics for nuclear power plants
- Propulsion systems for naval and space applications
- Nuclear safety and radiological protection
- Decision support systems for emergency preparedness and response
- Severe accidents
- Neutron detection and dosimetry
- Scientific methods for history and communication in nuclear energy

Aula José Cabrera Gas Natural-ETSII

Interactive graphical Simulator

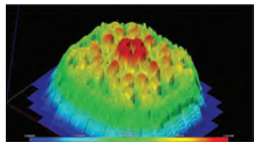




Nuclear safety Chair "Federico Goded" CSN-ETSII

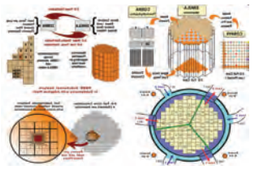
Nuclear Safety Chair "Juan Manuel Kindelán" CSN-ETSIM

Nuclear reactor safety simulation platform (Euratom)

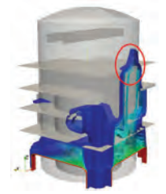


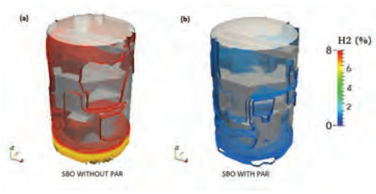
SEANAP System development (Sistema Español de Análisis de Núcleos de Agua a Presión)

Ascó I, Ascó II, and Vandellós Nuclear power plants

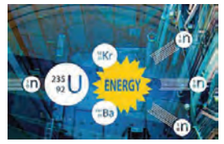


Cofrentes NPP hydrogen risk analysis and PAR installation (Iberdrola)

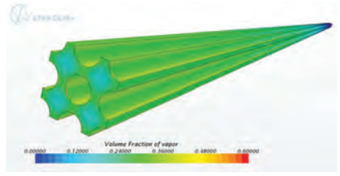




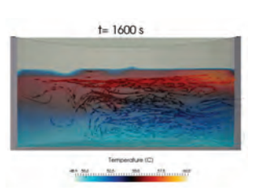
Graduate and Executive Nuclear Training and Lifelong Education (Euratom)

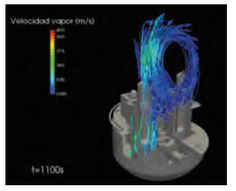


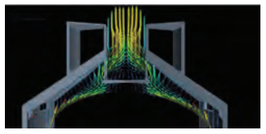
Boiling Water Reactor Fuel simulation with CFD codes (Iberdrola)



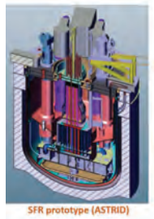
AP1000 containment analyses (Proyecto PYGAS, MINECO)

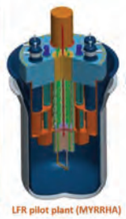


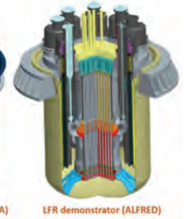




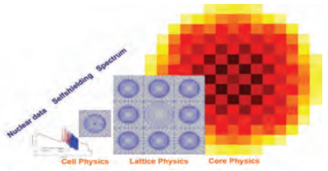
Preparing European Sustainable Industrial Initiative (Euratom)



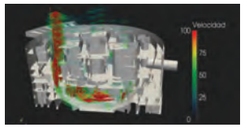


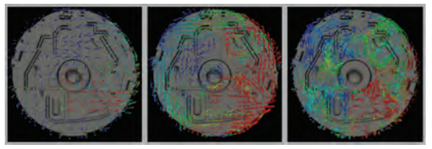


Uncertainty analysis in Modelling (OECD/NEA - CSN)

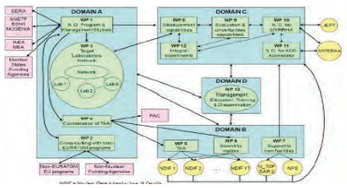


Almaraz and Trillo NPP containment thermal-hydraulics (CNAT)

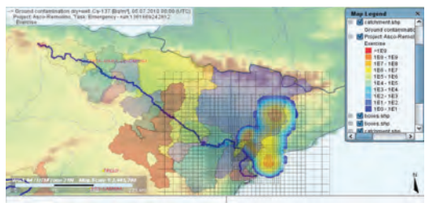




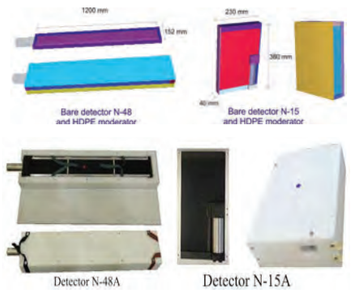
Solving Challenges in Nuclear Data for the Safety of European Nuclear Facilities (Euratom)

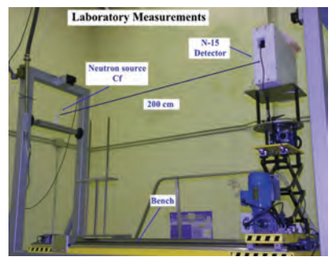


Integration of atmospheric dispersion models with river and lake catchment models in the JRODOS decision support system for nuclear accidents PREPARE project (EURATOM)



Study of neutron detectors for Radiation Portal Monitors ^{10}B+ZnS(Ag) as an alternative to ^{3}He (with ETSICCP-UPM)





INDUSTRIALES RESEARCH MEETING 17

to Inercial

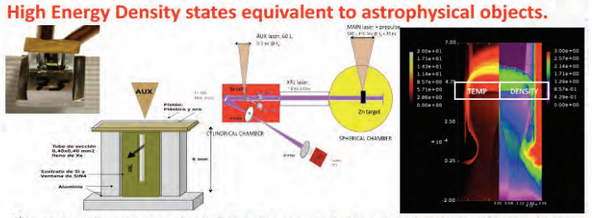
.es

IFN Instituto de Fusión Nuclear

POLITÉCNICA

Radiative Shock Waves

Reproducing Astrophysical phenomena at Laboratory scale.
Laser irradiation produces strong shock waves bringing matter to High Energy Density states equivalent to astrophysical objects.

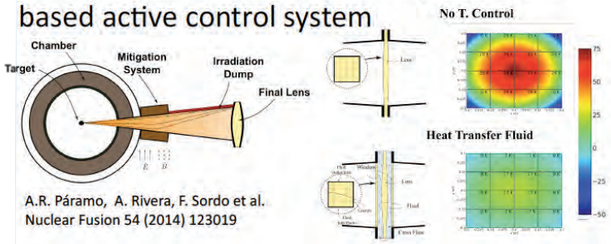


1)Laser AUX illuminates a plastic foil and creates a shock wave going down. This shock then goes through a tube filled with Xe.
2) Radiation produced by the shocked Xe preheats the gas ahead of the shock wave.
The coupling of hydrodynamics and radiation transport is key for reproducing radiative shock (Cotelo et al. High Energy Density Physics (2014) 1-6)
Experimental setup is shown at the left, simulations with 2D Rad transport to the righ (Stehlè et al, Optics Communications 285 (2012) 64-69

M. Cotelo, A. G. De la Varga, D. Portillo and P. Velarde

Fusion plant components

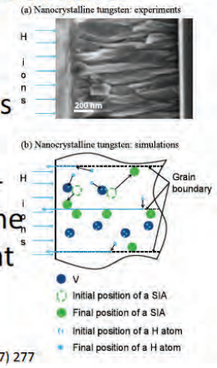
Example ICF chamber and lens systems:
To keep temperature uniformity on lenses (origin of aberrations), we designed a fluid-based active control system



A.R. Páramo, A. Rivera, F. Sordo et al.
Nuclear Fusion 54 (2014) 123019

Light species in materials

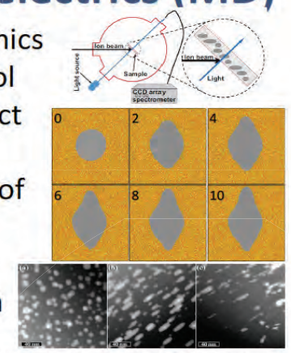
Object kinetic Monte Carlo (OKMC) is used to study and prevent the detrimental effects of mainly H and He in fusion materials. Example: H in nano-W can be followed in detail. The main positive conclusion is that H escapes through grain boundaries



Valles et al. Acta Materialia 122 (2017) 277

Irradiation of dielectrics (MD)

We use Molecular Dynamics (MD) simulations as a tool to study dielectrics subject to swift ion irradiation, including the elongation of embedded plasmonic nanoparticles. Example: 40 MeV Br ion irradiation of Ag nanoparticles

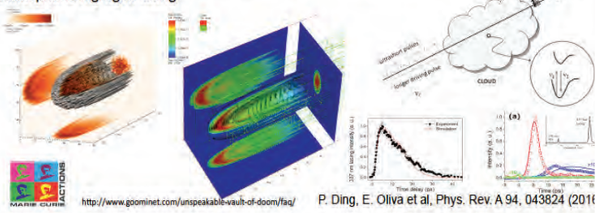


O. Peña-Rodríguez et al. Sci. Reports Accepted

Maxwell-Bloch modelling of XUV lasers

DAGON: A 3D Maxwell-Bloch solver
-DAGON models the 3D propagation and amplification of XUV pulses through plasma amplifiers.
- It is fully parallelized and uses the Adaptive Mesh Refinement paradigm.
-It will be used to study plasma based soft X-ray lasers and the influence of filament inhomogeneities in atmospheric nigrogen lasing.

Modelization of atmospheric Nitrogen lasing with DeepOne, a 1D Maxwell-Bloch
- XUV radiation fromospheric Nitroge is an excellent probe for contaminants
- The backwards amplification of XUV stochastic emission is modelled with DeepOne

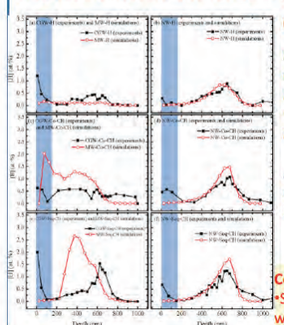


http://www.goominet.com/unspeakable-vault-of-doom/faq/

P. Ding, E. Oliva et al, Phys. Rev. A 94, 043824 (2016

J. C. Escudero, A. Sanchís, J. Vera, S. Vicens, P. Velarde and E. Oliva

Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained tungsten



Motivation: *H and He tend to nucleate defects resulting in cracking, exfoliation blistering.*
•One option to improve the radiation-resistar is to develop nanostructured materials.

Aim: Study both experimentally and b computer simulations the role of grai boundaries on:
•The radiation-induced defect evolution
•The H retention

Conclusions:
•Self-healing would happen at temperatures which the mobility of vacancies is activated.
•GBs favour H release. NW exhibits highe radiation resistance than CGW.

G. Valles *et al.* Acta Materialia 122 (2017) 277e286

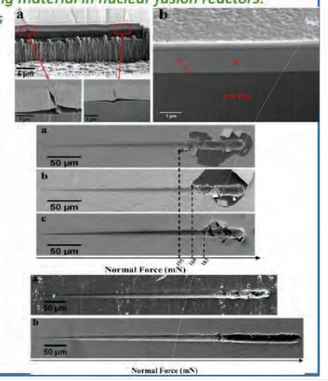
Adhesion of nanostructured tungsten (NW) coatings to SS substrates

Motivation: *W is proposed as plasma facing material in nuclear fusion reactors. The adhesion of W to the structural steel is a point of concern.*

Aims:
Investigate the adhesion as a function of:
•Steel roughness for bare substrate
•Presence of a Cr interlayer.

Conclusions:
•For NW samples deposited onto bare steels: the lower the roughness the higher the adhesion.
•The Cr interlayer improves the adhesion and eliminates its dependence on the substrate roughness.

M. Panizo *et al.* submitted to Jour. of Nucl. Mat.

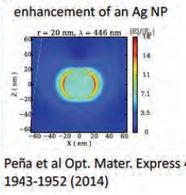


Plasmonic Nanoparticles

Fabrication by PLD of NPs and simulation of their optical properties by means of diverse methods (FDTD, Mie theory, T-Matrix) for applications like SERS, local heating, energy confinement, etc.

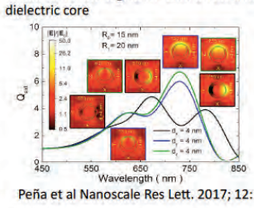
Ag NPs fabricated by PLD

Electric field enhancement of an Ag NP



Peña et al Opt. Mater. Express 4, 1943-1952 (2014)

Extinction spectra and corresponding field enhancement of a gold NP with an eccentric dielectric core



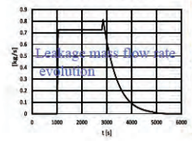
Peña et al Nanoscale Res Lett. 2017; 12: 16

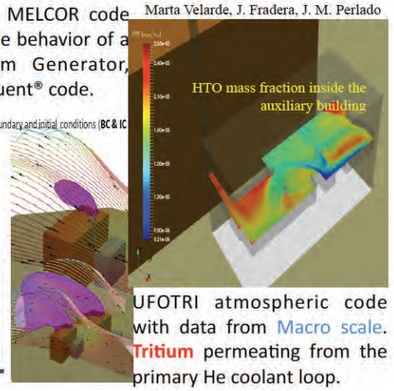
Analysis of TRITIUM Leakages

Marta Velarde, J. Fradera, J. M. Perlado

Micro scale analysis. MELCOR code in order to analyze the behavior of a leakage at a Steam Generator, coupled to ANSYS® Fluent® code.

Macro scale analysis using **SC and CFD**. In this case, the same coupling problems arise for SC-CFDg.



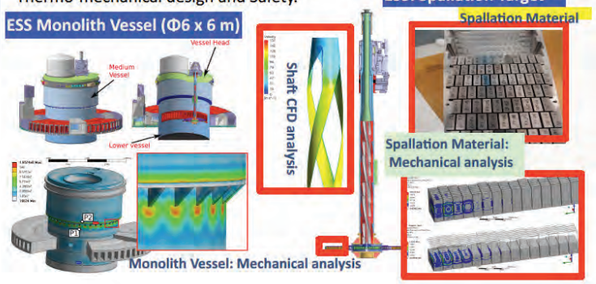


UFOTRI atmospheric code with data from Macro scale. Tritium permeating from the primary He coolant loop.

EUROPEAN SPALLATION SOURCE

ESS bilbao

Neutron sources and nuclear engineering: European Spallation Source
•INF is working on the design of nuclear components for the
•**European Spallation Source:** Target, Monolith Vessel, Proton Beam Window, Tunning Beam Dump ...
•The design of this components includes Neutronics, radiation damage, Thermo-mechanical design and Safety.

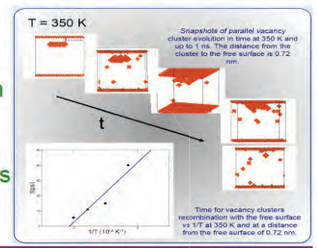


Structural Materials Irradiation Damage: Molecular Dynamics Simulations

Accurate interatomic potentials (IP) are key in Molecular Dynamics calculations. An original IP Concentration Dependence Model (CDM) version describes adequately point defects in Ferritic Steels.
Linear dependence of vacancy formation energy on Cr Concentration were observed for concentrations > 6% but almost constant for those < 6 %.
(E. del Rio, J.M. Perlado, et al., J. Nuc. Mater. 408 (2011) 18-24)

Two main goals are actually proposed:
•Stability of Vacancy Loops close to Surface in α-Fe

•Cr segregation to defects created by irradiation in FeCr alloys.

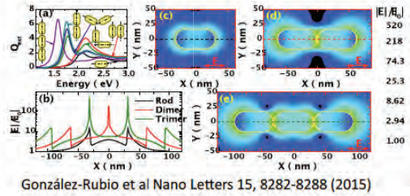


LAMMPS (MD simulation), OVITO (visualization), olkmc: *a hybrid kMC-MD code (Los Alamos)*

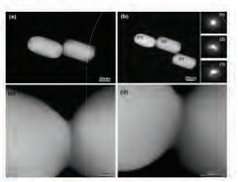
Irradiation of NPs with fs lasers

A light-controlled synthetic procedure allows obtaining selected plasmonic oligomers by irradiation with low fluence near-infrared femtosecond laser pulses.

Optical extinction spectra and local field enhancement of single AuNRs, rod dimers and trimers



HAADF-STEM images of dimers and trimers of AuNRs



González-Rubio et al Nano Letters 15, 8282-8288 (2015)

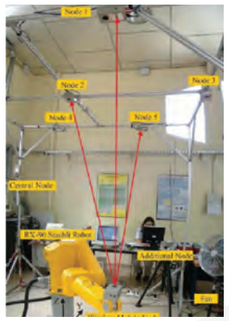
INDUSTRIALES RESEARCH MEETING 17

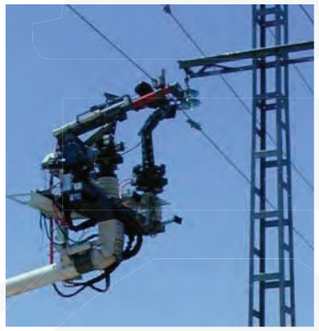
cs UPM-CSI

CAR
CENTRE FOR AUTOMATION AND ROBOTICS

UNIVERSIDAD POLITÉCNICA MADRID
POLITÉCNICA

The Centre for Automation and Robotics (CAR) is a joint research center of the Spanish Council for Scientific Research (CSIC) and the Universidad Politécnica de Madrid (UPM).





The main objective of CAR is to develop applied research which aims at offering useful results for the society in the field of Robotics and Automation. CAR is vey well positioned in order to lead its ambitious research program, putting research on the following scientific-technological areas:

- **Control Engineering,**
- **Artificial Perception, and**
- **Robotics.**

The work carried out at CAR is funded by research agreements with private companies and by competitive institutional programs, both national and international, such as the European Commission, National Plan for R&D+I, Madrid Regional Government and AECID, among others. These activities lead to a large number of collaborations with private companies and other research centers. The research activity of CAR is strategically linked to the training of UPM postgraduate students. It includes Master's Degree and Doctorate Degree Programs in Automation and Robotics. More than 120 researchers are integrated the CAR, which are members of the following groups:

- **AUTOPIA- Automated Driving of Vehicles.**
- **Computational Cognitive Robotics.**
- **Robots and Intelligent Machines.**
- **Service Robotics.**
- **Robotics and Cybernetics.**
- **Intelligent Control.**
- **Intelligent Automation of Manufacturing Processes**
- **Computer Vision.**
- **Artificial Perception.**
- **Autonomous System.**
- **Intelligent Systems Localization and exploration.**

INDUSTRIALES RESEARCH MEETING 17

Computer Vision & Aerial Robotics

gi.visionaerialrobotics@upm.es

http://www.vision4uav.com

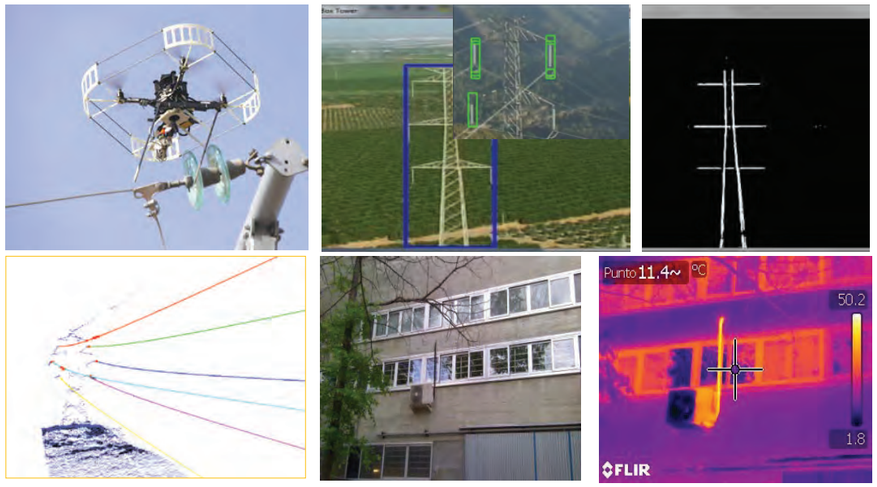
vision4UAV

CAR CENTRE FOR AUTOMATION AND ROBOTICS

POLITÉCNICA

Our Vision: The CVAR Group at U.P.M. is focused on providing **UAVs with their maximum degree of autonomy** for their use in civil and industrial applications. For this purpose we use **Vision as a powerful sensor** that provides a huge amount of valuable information for UAVs and their **localization related to its environment**, in a similar way as vision does for human beings.

Industrial inspection using LIDAR, RGB and IR cameras



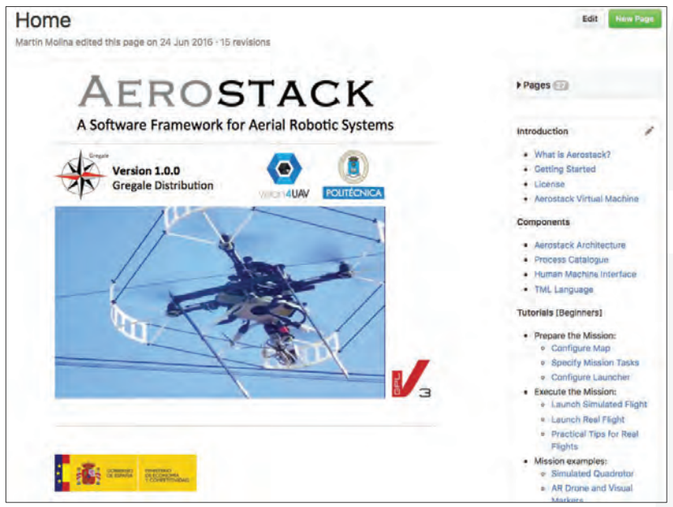
Autonomous Guidance and Navigation

See & Avoid

Natural environments monitoring

- ***Our Mission:*** Being at the front end of the technology in Image Processing and Control techniques in order to achieve technology transfer of U.A.S. into demanding civil applications.
- ***Our Values:***
  - Being permanently updated with the latest **cutting edge technology and R&D** in many related fields is essential for complete innovative solutions
  - Having **challengeable aims and testing** the proposed solutions are two essential components for improving our research and products
  - **International cooperation** is important for enriching the knowledge and the solutions

Own open source Sw framework, including some of our Sw moduls. www.aerostack.org



Some vehicles of our Unmanned Aerial fleet

INDUSTRIALES RESEARCH MEETING 17

Intelligent Control

agustin.jimenez@upm.es

http://www.car.upm-csic.es/about-us/research-groups/intelligent-control/

CAR CENTRE FOR AUTOMATION AND ROBOTICS

UNIVERSIDAD POLITÉCNICA MADRID

POLITÉCNICA

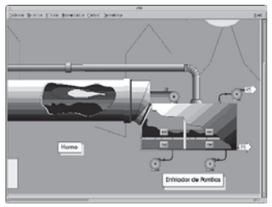
FUZZY LOGIC & CONTROL

The research started in the early 90's in order to apply fuzzy logic technology in control systems. A lot of theory and industrial applications has been developed since then by the research group. Design methods of fuzzy controllers based on their analogy with PID control, state estimation using fuzzy logic, variable structure control, of fuzzy modeling are examples of the developed know-how.

On the other hand, applications of fuzzy logic have been demonstrated in a wide number of fields, from process control to robotics, in cases where controllers can be designed based on expert knowledge.

PROTOTYPES:

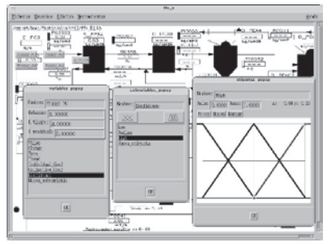
Different applications have been developed for industrial partners, such as ASLAND, REPSOL, VEKA IBERICA, ENUSA or ELIOP. Fuzzy logic is applied in different fields, such as fuzzy control, sensor validation or diagnosis.

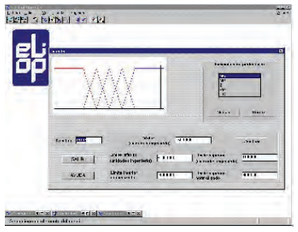


Cement industry

Petrochemical Industry

Extrusion Process





Examples of Fuzzy logic tools developed for REPSOL and ELIOP

EXPERTISE AND EXPERIENCE:

- Fuzzy controller design techniques.
- Fuzzy modeling and systems identification.
- Variable structure and fuzzy logic.
- State estimation using possibilistic techniques.
- Fuzzy diagnosis systems.
- AMFE methodologies.

RELATED PROJECTS:

- **CONEX**: Industrial Process Controller of Continuous Processes based on Expert Systems and Fuzzy Techniques (1990-1992). Funded by ASLAND Technology.
- **HINT**: Heterogeneous Integration Architecture for Intelligent Control Systems (1992-1994), ESPRIT-6447.
- **EXEX**: Intelligent System for Extrusion Control (1995-1998), funded by Veka Ibérica S.A.
- **TOPKAPI**: Application of Fuzzy Logic Techniques to ELIOP Industrial Controllers based on Programmable Logic Controller ELI-4000 (1995-1997). Funded by CDTI.
- **SINCRO**: Intelligent System for the Ceramic Process Control using FMEA Methodology (1995-1996), funded by ENUSA.
- **DIXIT**: Distributed Information Technology for Strategic Muti-objective Process Control (1996-1998) ESPRIT 22130.
- **ROBINT**: Integration of Intelligent Behaviors for Guide Robots (2005-2007), DPI-2004-07907-C02.

SOCIAL ROBOTS FOR THE ELDERLY, HOSPITALS, MUSEUMS AND TRADE FAIRS

The research started in the 90's in order to cover the emerging field in mobile robotics. Since the initial work on navigation control, planning and mapping, with the beginning of the new century the focus switched to guide robots with richer interaction and navigation capabilities, including SLAM.

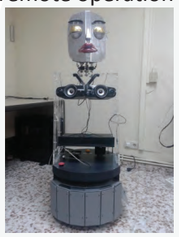
This kind of social robots are being widely investigated in the robotics field and are appropriate for a number of applications such as medical and elderly assistance, tour guide, commercial exhibitions or entertainment.

PROTOTYPES:

Three prototypes have been developed till now: Blacky (2000), Urbano (2004) and Doris (2014). The main features of these robots are autonomous navigation, facial expression, voice dialogues and remote operation via web and tablet.

BLACKY at Madrid for Science fair

URBANO



DORIS

Urbano at Valencia Prince Felipe Museum

EXPERTISE AND EXPERIENCE:

- Safety navigation based on laser and computer vision.
- Sensor fusion techniques for robot localization and environment mapping.
- SLAM using geometric representation and B-Splines.
- Mechanical head and arms with servos for expressing emotions designed ad-hoc.
- Voice recognition and speech synthesis in several languages for human like conversations.
- Remote operation via touch screen and web services, including chat and voice communication.

RELATED PROJECTS:

- WEBFAIR: Web Access to Commercial Fairs through Mobile Agents (2001-2004), IST-2000-29456.
- URBANO: Autonomous Robots Integration in Society by using New Technologies (2002-2004), DPI01-3652-C02.
- ROBINT: Intelligent Behaviors Integration for Guide Robots (2005-2007), DPI-2004-07907-C02.
- CRAWLER: Autonomous Robot for Carbon Fiber Inspection with Pulse-echo Techniques (2005-2008). Funded by Airbus Spain.
- ROBONAUTA: Knowledge Models Integration for Autonomous Start-up of an Interactive Robot (2008-2010), DPI-2007-66846-C02.
- ARABOT: An Interactive Autonomous Robot Abel to Reason in an Dynamic Environment (2011-2014). DPI 2010-21247-C02.
- NAVEGASE: Natural Language Aided Navigation (DPI 2014-53525-C3-1- R). 2015-2017

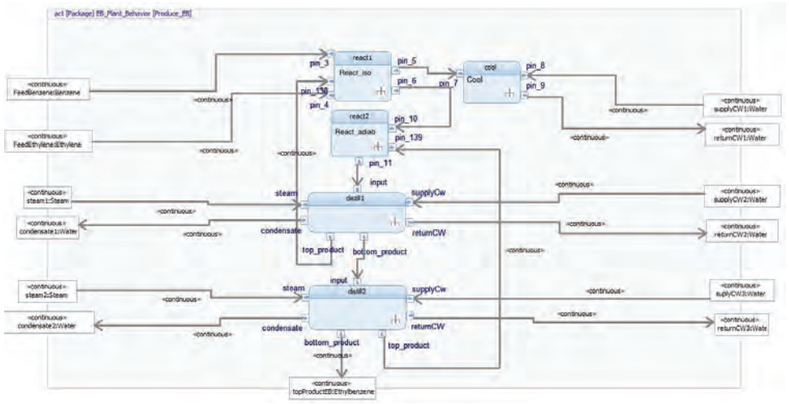
UPM Autonomous Systems Laboratory (ASLab)

info@aslab.org

http://www.aslab.upm.es

About the Autonomous Systems Laboratory

- UPM-ASLab performs research on **Autonomous Systems**, i.e. systems that operate by themselves without the need of external intervention and guidance. Autonomous systems are useful in many real-life situations for economical, technical or safety reasons.
- We develop **science** and **technology** for the **construction of systems for the real world**, so they will free humans from supervising them once they're up and running. They will self-manage to fulfil objectives.
- We address needs in the wider domain of technical systems. We focus our work on the domains of **robotics** and **chemical processes**, but trying to get results of universal applicability.



Ongoing Work

- Focus on **control and artificial intelligence** to improve system **robustness** and **resilience**.
- How to represent and **reason about systems engineering knowledge** to provide run-time, engineering-based adaptation of systems.
- Exploring the use of **SysML** as a language to **break the engineering/runtime gap.**

Past Research Projects

HINT: Heterogeneous Integration Architecture for Intelligent Control Systems / **DIXIT**: Distributed Integration Technology for Strategic Control Systems / **DOTS**: Distributed objects for Telecontrol Systems and Networks / **HRTC**: Hard Real-Time CORBA / **COMPARE**: A Component Approach to Real-time and Embedded / **C3**: Conscious Cognitive Control / **ICEA**: Integrated Cognition, Emotion and Autonomy / **GENESYS**: Generic Embedded Systems Platform / **HUMANOBS**: Humanoids that Learn Socio-communicative Skills by Imitation / **HBP**: Human Brain Project

Some Recent Publications

Hernández et al. **Model-based engineering of process plants using SysML**. In European Symposium on Computer Aided Process Engineering, ESCAPE 26, Portoröz, Slovenia, June 12-15, 2016.

Bayat et al. **Requirements for building an ontology for autonomous robots**, Industrial Robot: An International Journal, Vol. 43 No. 5, 2016.

Rodriguez and Diaz. **A systematic and integral hazards analysis technique applied to the process industry.** Journal of Loss Prevention in the Process Industries, Vol. 43, pp. 721-729, 2016.

Rodriguez et al. **Process Systems Lifecycle Management using a Model Based Engineering Approach**. AIChE Annual Meeting, San Francisco, 13-18 October, 2016.

Bermejo, Hernández and Sanz. **Model-based engineering of autonomous systems using ontologies and metamodels.** IEEE International Symposium on Systems Engineering 2016, Edinburgh, Scotland, 2016.

Get in contact: info@aslab.org

Automática y Robótica: **Ricardo.Sanz@upm.es** Ingeniería Química: **Manuel.Rodriguezh@upm.es**

One project under way in more detail

- Developing an **autonomous robotic system for emergencies**.
- Funded projects by the Spanish government.
- Participants:

  IXION (project leader)

  UPM (Computer Vision and Autonomous Systems groups)

  Universidad Carlos III de Madrid.
- ADVISE - Sistema Autónomo de VIgilancia y SEguridad basado en multirotores

  Development of an aerial robotic system of less than 2kg, integrated within a security system, to **perform perimetral surveillance tasks automatically and autonomously**, both indoors and outdoors, using an embedded and configurable HW / SW system.
- SALINE - Sistema Autónomo para La INtervención en Emergencias

  Provide a high degree of autonomy to a cooperative group of vehicles without pilot (UGV-UAV) capable of acting in dangerous or emergency environments. The limited ability to operate autonomously hinders entry into the market. This is the core point of innovation, by providing a system with **greater capacities of perception and reasoning, to produce improved autonomy robots.**

- The responsibilities of UPM-ASLab in this project are to:
  - Build a **cognitive autonomous mission layer** to handle high-level mission specifications.
  - Develop **reaction capabilities** to handle unexpected events during mission execution.
  - Provide a cognitive, seamless **integration of human operators** with the autonomous system.

Image courtesy of IXIO S.A.

INDUSTRIALES RESEARCH MEETING 17

Robótica y Cibernética - Grupo de Investigación

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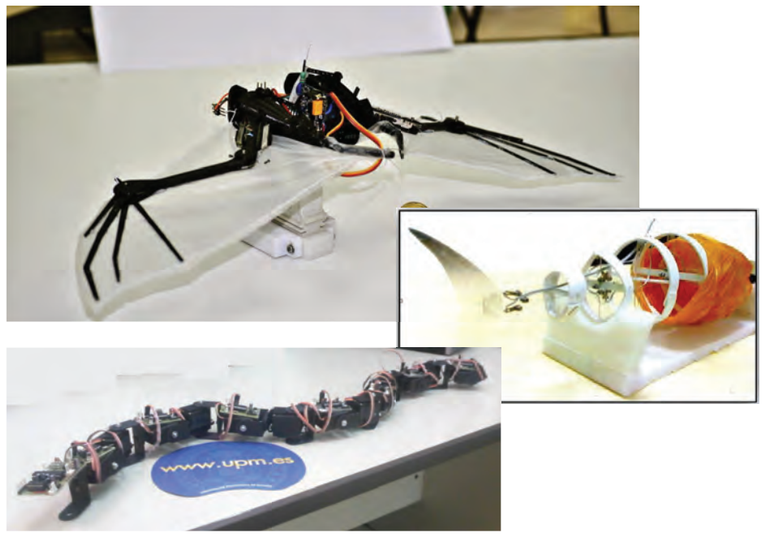
Robótica & Cibernética

POLITÉCNICA

Bio-inspired robotics



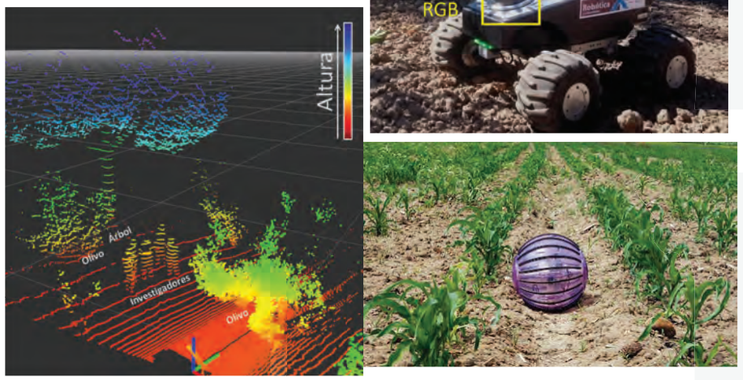
Robotics for agriculture applications

Greehouse farming

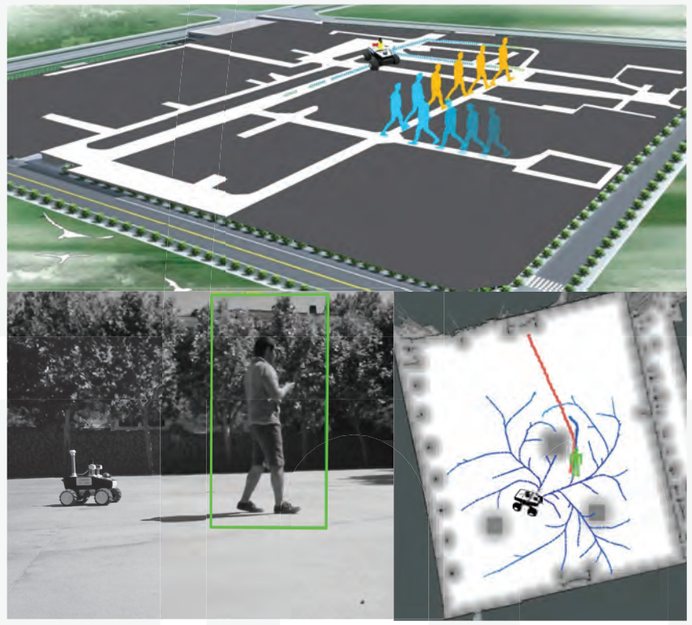
Robotics for security and urban search & rescue

Search & rescue

Cooperative robotics



Precision agriculture



Surveillance and security

INDUSTRIALES RESEARCH MEETING 17

Grupo de Robots y Máquinas Inteligentes

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GRMI
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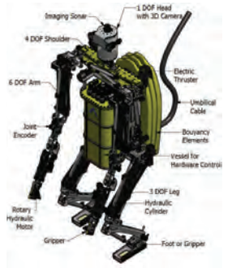
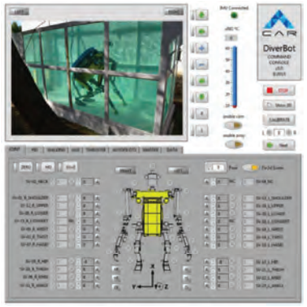
CENTRE FOR AUTOMATION AND ROBOTICS

POLITÉCNICA

TO PROJECTS: DEVELOPMENT OF ROBOTS FOR WORKS IN SUSTAINABLE UNDERWATER AGRICULTURE

DIVERBOT: UNDERWATER HUMANOID ROBOT FOR WORKS ON SEABED





This project presents an underwater humanoid robot called diverBot developed to work on seabed. The robot has 23 DOF and can navigate as ROV moved by marine propellers and change its configuration from ROV to humanoid deploying four anthropoid arms to crawl or climb on the seabed. The concept of a robot that change from ROV to-anthropoid is essential in order to work on the seabed since short distance navigation from the surface without colliding with obstacles is impractical due to the effects of underwater sea currents. On the other hand, traveling on rough terrains is not easy without using four limbs to keep its balance. Therefore, the investigation of a technology which works in the seabed has been the main motivation for the development of a transformer robot that can navigate until the proximity of the objective and then unfold as humanoid robot for working.

ACKNOWLEDGMENT

The authors would like to thank the financial support of Spanish Government CICYT Project Ref. DPI2014-57220-C2-1-P, DPI2013-49527-EXP Universidad Politécnica de Madrid Project Ref. AL14-PID-15 and also to Comunidad de Madrid who supports the project ROBOCITY2030-III P2013/MIT-2748

Patent

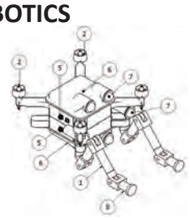
Robot submarino humanoide transformable (Patente de invención con EXAMEN PREVIO)
Nº de solicitud: P201430253

Publications

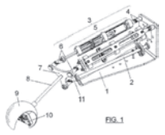
Puglisi, Lisandro J.; Saltarén, Roque J.; Garcia, Cecilia; et ál. "Robustness analysis of a PI controller for a hydraulic actuator "CONTROL ENGINEERING PRACTICE Volumen: 43 Páginas: 94-108 Fecha de publicación: OCT 2015
Puglisi Lisandro, "Advanced Control Strategies for a 6 DoF Hydraulic Parallel Robot Based on the Dynamic Model", PhD thesis Universidad Politécnica de Madrid, 2016.
DiverBot: A humanoid transformer robot: Experimental results https://www.youtube.com/watch?v=Q7H5KtS8NBI

PROJECTS & PATENTS FOR UNDERWATER ROBOTICS

Patent: Modular submarine robot. ES2544007 (B2) 2016-02-19
The present invention relates to a modular underwater robot with a plurality of arms which is transformable in ROV to work seabed and marine constructions, it is a robot with arms humanoid morphology corresponding to the Kinematics proportions of a human for work and / or to move and climb using their limbs. The object of the invention to provide a single device or robot modular scalable in the number of robotic arms that can combine browsing functionality, handling and moving in any direction thanks to their configuration and marine impellers robotic arms.



Device and method for measuring fluid streams by spherical parallel mechanism actuated by drag forces. ES2538415 (B2) 2015-11-03
The present invention is a fluid meter which calculates current speed and direction of a fluid according to the drag force it exerts on a solid body. Comprises a spherical parallel mechanism comprising a fixed (1) spherical motion base that allows a mobile platform (7) by a mast (2) and two kinematic chains (3). Integral with the platform (7) a tube (8) carries a spherical container (9) provided inside an inertial measurement unit (10), which records the spatial orientation of the platform (7) on the fixed base (1) generated by action of the fluid on the spherical container (9). This device can be used for measuring water or air currents, as a support vessel in navigation and measurement of fluid streams in channels or pipes.



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TELEROBOTICS, TELEMANIPULATION AND REMOTE HANDLING

Telerobotics, Telemanipulation and Remote Handling

Telerobotics covers all technologies that allow a human operator to remotely control a robot. The most advanced telerobotics systems are based on multimodal interfaces that include haptic interaction, stereoscopic visual perception and voice communication. The role of the human operator varies from mere task monitoring to guiding a robot for the execution of the manipulation task.

Traditionally, telerobotics have been applied in nuclear, space and underwater applications. New fields of Telerobotics, such as telesurgery, inspection and maintenance, and security among others are currently growing.

FACILITIES:

There is a setup for testing and developing new methods for Telemanipulation and the main components are as follows:

-Two hydraulic powered telemanipulators with 6 degree of freedom,
-Several master arms with force feedback,
-Stereoscopic video cameras that reproduce human binocular vision,
-Real-time computers for bilateral controllers

EXPERTISE AND EXPERIENCE:

Main expertise and experience are related to:
- Design and development of telerobotic systems,
- Definition and evaluation of remote handling procedures,
- Evaluation of interfaces, such as haptic devices and stereoscopic displays,
- Design of new methods for telemanipulation.

Recent projects

- **TeleScale**: Development of new teleoperation technologies oriented towards human-robot interaction for applications with highly scaled manipulation, funded by the Spanish National Plan of Research, DPI2012-32509 (2013-2016), http://www.car.upm-csic.es/?portfolio=telescale
- **PURESAFE**: Preventing hUman intervention for incrREased SAfety in inFrastructures Emitting ionizing radiation, funded by FP7 Marie Curie ITN-GA-2010-264336 (2011-2015), http://webhotel2.tut.fi/iha/puresafe/
- **TEMAR**: REMOTE MANIPULATION TECHNIQUES FOR NUCLEAR FUSION RESEARCH CENTERS, funded by Spanish National Plan of Research, DPI2009-12283 (2010-2012) http://www.car.upm-csic.es/?portfolio=temar
- **GOT-RH**: GOAL ORIENTED TRAINING FOR ITER REMOTE HANDLING MANIPULATORS, funded by Euratom (2010-2013), http://webhotel2.tut.fi/iha/got-rh/

Publications:

- J. Barrio, M. Ferre, FA. Suarez, R. Aracil. "**A Remote Handling Rate-Position Controller for Telemanipulating in a Large Workspace**", Fusion Engineering and Design, vol. 89 (1). 2014. doi: 10.1016/j.fusengdes.2013.11.003.
- Manuel Ferre, Ignacio Galiana, Raul Wirz and Neil Tuttle, "**Haptic Device for Capturing and Simulating Hand Manipulation Rehabilitation**", IEEE Transactions on Mechatronics, vol. 16 (5). 2011, doi: 10.1109/TMECH.2011.2159807.
- Manuel Ferre, Ignacio Galiana and Rafael Aracil, "**Design of a Lightweight, Cost Effective Thimble-Like Sensor for Haptic Applications Based on Contact Force Sensors**". Sensors, 2011, doi: 10.3390/s111211495.
- R. Wirz, R. Marin, M. Ferre, J. Barrio, J.M. Claver and J. Ortego, "**Bidirectional Transport Protocol for Teleoperated Robots**", IEEE Transaction on Industrial Electronics, vol. 56 (9), 2009, doi: 10.1109/TIE.
- Manuel Ferre, Rafael Aracil, and Miguel A. Sánchez-Urán, "**Stereoscopic Human Interfaces**", IEEE Robotics and Automation Magazine, vol. 15 (4), 2008, doi: 10.1109/MRA.2008.929929.

Patents:

- Patent: P201132146. "**Method for telerobotic guidance by switching rate and position control modes**", M. Ferre, R. Aracil, J. Barrio and F.A. Suárez.
- Patent: P200000257. "**Tremor characterization by applying force patterns**", A. Barrientos, M. Ferre, R. Gonzalez, A. Mora, J.L. Martínez and R. García.
- Patent: P9801372. "**Stereoscopic video camera**", M. Ferre and A. Barrientos.

Keywords:
Telerobotics
Remote Handling
Telepresence
Telemanipulation
Bilateral control
Haptic devices
Binocular perception

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ROBOTICS FOR MEDICAL APPLICATIONS

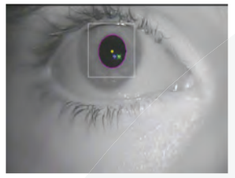
Robotics for Medical Application

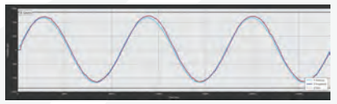
OSCANN is a medical devices developed in order to assist in the diagnosis of neurodegenerative disease like Alzheimer, Parkinson, Parkinsonism , etc and in neurodevelopmental disorder like Autism, hyperactivity, Tourette Syndrome.

The eye movement is recorder while the patient follows some visual stimulus. The devise has an international patent and the level of TRL is 9.
The devise was manufactures follows all regulation in Europe and it is classified as "Clinical Test Device" for the *Agencia Española del Medicamento y Productos Sanitarios* and actually it under clinical test in eight Hospital in Spain.

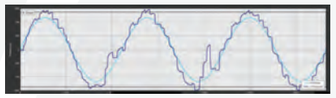
After one year of clinical test, we will get a biomarket for each disease .

There are scientific evidence , since a neurosciences point of view, that the device can be used for neuromarketing and for evaluation psychological condition of a person (terrorism, paedophile, gender-based violence).





Slow Movement test: Healthy Man: 36 years-old



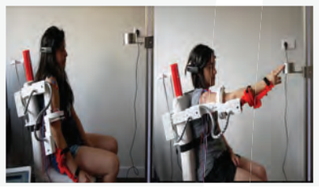
Slow Movement test. Woman 49 years-old. Ataxia

ORTE is a upper limb robot for rehabilitation and neuro-rehabilitation. It is focus in the shoulder and elbow rehabilitation.

The main objective of ORTE System is to be a powerful rehabilitation and neuro-rehabilitation that help to medical staff to:

1. Diagnoses
2. Personalized the therapy
3. Objective measurement of the evolution of the disease.

There is not any rehabilitation system (upper o lower limb) that makes all in real time. The system is easy to use for medical staff that can set up the machine for each patient (movements to be done and kinematical parameters of the movement)
The ORTE System has a muscleskeletal model that allows to simulate both, the pathology and the effect of the rehabilitation movement given all the biomechanical parameters of the limb. After this the medical staff can program the movements is a very easy way.
Kinematics parameters, EMG and EEG signal can be recorder during the therapy.
The level of technology is 7 and we plan to reach the level 8 at the end of this year.



First clinical test with Healthy peolple

ORTE System

AURA Innovative Robotics SL is the spin-off of the research team and is going to the market with both medical devices (www.aurarobotix.com)

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Centro de Electrónica Industrial

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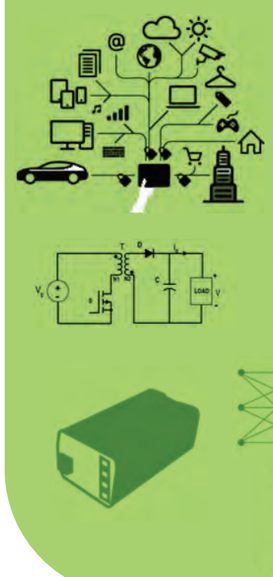
Mission

The mission of the **Centro de Electronica Industrial** is to create knowledge, develop applications, transfer technology and educate engineers and researchers, in close cooperation with industrial partners in the field of industrial electronics. The goal of the Center is to foster the synergy around the industrial electronics in different terms:

- **Providing research areas**: electrical energy conversion through electronics, embedded digital systems and power quality service.
- **Industrial program focused**, but not limited, to aerospace, industrial, telecom and automotive industry.
- **Post-grad program**. The master and doctorate program on Industrial Electronics bridges the industrial sector with the students.
- **Encourage of the interaction of the different companies involved in research activities in the CEI-UPM**. The common and complementary research lines of the companies can be identified in order to create new research activities providing new solutions to the industry.

Grupo de Electronica Industrial (GEI)



1. AC-DC and DC-DC power converters
2. Device modelling
3. Energy Harvesting
4. Smart Grids
5. Internet of Things and Wireless Sensor Networks
6. Reconfigurable FPGA Based Systems
7. Embedded Intelligence
8. Neural Networks
9. Art and Technology

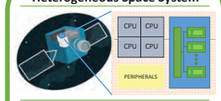
Grupo de Ingeniería de Radio (GIRA)

1. RF and Microwave circuits
2. High Frequency Amplifiers
3. Digital Signal Processing
4. Communication networks
5. MIMO techniques for communications

Micro/Nano Smart Grids

Modeling Electronic Power Converters in AC and DC Micro/Nano Smart Grids to foresee its dynamic performance and stability at system level
Several large-signal, nonlinear models have developed and tested

Heterogeneous Space System



The main goal of this line is to develop systems that, at runtime and dynamically, adapt themselves to a variety of computing fabrics (CPUs, FPGAs, GPUs…) with particular attention in hardening to make them survive in harsh conditions.

Wireless Power Transfer

This research line is focused on efficient wireless transmission of electric power for electric vehicles, mobile devices and medical implant devices

Power Electronics for Space Applications

This research line tries to provide innovative solutions in the field of Electronic Power Processing in Space with tight collaboration with strong industry groups established in Spain.

Embedded Intelligence

This is one of the most promising approaches for facing complex systems design: Adaptive/Cooperative learning and Artificial Neural Networks based HW systems are the near future challenges

Art and Technology

The knowledge belonging to engineering, electronics and computer science is applied to art compositions, resulting in innovative creations with surprising results for the audience

Power Supply on Chip

This research line is focused on the optimization of power supply on chip covering critical aspects like the architecture, the topology, the control and the optimization of the magnetics and the capacitors

Inter-turn testing of alternators

We develop in this line a system to test the inter-turn isolation in automotive alternators. This is a critical defect that can shorten the life of the alternators. An early detection of this defect ensures the product quality.

The More Electric Aircraft

This research line covers from the modeling and simulation of distributed power architectures to the design of advanced power converters for the More Electric Aircraft

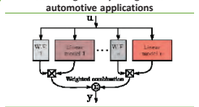
Little Box Challenge

This competition challenges engeneering teams to create the highest power density power inverter design. Developing a solution for a 2 kW, 450 VDC to 240 VAC, 60 Hz inverter, with strict voltage and current ripple requirement.

Wireless Sensor Networks

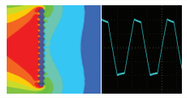
In this line, the deployment of wireless distributed systems is faced, applying the concept to several app scenarios such as smart traffic management, energy metering, agricultural control, urban participatory sensing, etc.

Modeling battery chargers in automotive applications



Black-box Polytopic Modeling applied to automotive battery chargers let us to asses the impact of these converters in the grid

Bio-engineering applications

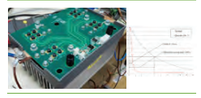


Specific power supplies to generate magnetic and electric field for several bioengineering applications such as Magnetic Hyperthermia and Tumor Treating Fields

Digital Signal Processing

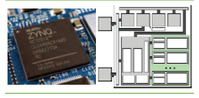
Radio software, MIMO, digital signal processing for RADAR systems. Implementations in FPGA and Digital Signal Processors

Electronic Protections



Development of electronic protections based on power semiconductors for synchronous brushless generators

Reconfigurable Architectures

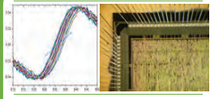


This line focuses on developing embedded parallel computing platforms based on HW acceleration, to obtain energy-efficient, scalable, and run-time adaptive solutions by "copy & paste" of actual circuits inside chips

3D Vision for CPS

We are researching on the generation of 3D models from visual information, under real-time and embedded processing constraints. Special emphasis is placed on Cyber-Physical Systems (CPS) applications.

Smart sensor interfaces

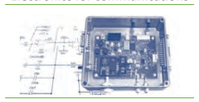


In this line, CEI-UPM is developing new embedded circuits for advanced interfaces of complex sensors, based on HW/SW embedded signal processing and machine learning techniques

Power supplies for accelerators

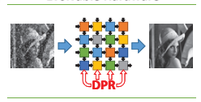
Design and manufacturing of the power supplies of the superconductive magnets of the XFEL accelerator

Electronics for communications



Design of power amplifiers for telecommunications, RADAR, SONAR, emitters and receivers

Evolvable Hardware



Dynamic partial reconfiguration of FPGAs allows building digital circuits that **evolve** adapting to a task, resulting in **autonomous, self-adaptive,** and **self-healing** hardware that will be suited for hostile environments such as space applications.

Ultra efficient and ultra compact power supply for PV applications

We designed and built a power supply for a PV application capable of processing 15kW with efficiency as high as 99.5% (75W of power losses). The volume of the design was not higher than 400cm^3 (40kW/dm^3).

Internet of Things

In this line the implementation of networked embedded systems is addressed to face the main challenges related to this ongoing era of smart and sustainable cities, comprising the integration of heterogeneous hardware and software technologies.

Energy Harvesting

Different solutions for taking advantage of surrounding energy sources are proposed in order to optimize the power conversion efficiency with multiple sources as thermal, vibrations, sun light, water flow, etc.

INDUSTRIALES RESEARCH MEETING 17

Centro Láser UPM

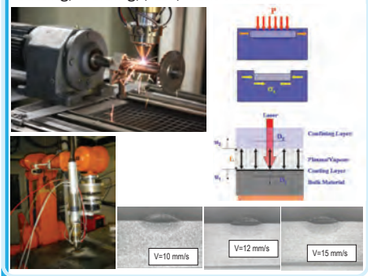
POLITÉCNICA

Presentation

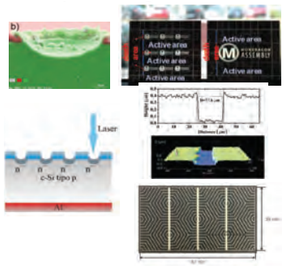
- The Laser Centre UPM focus its activity in the following areas:
- Applied research and technological transfer in the field of laser material processing.
- Services for industry include laser plant technology implementation, process scalability, automation and numerical modelling of laser based processes.
- Teaching and training activities include personalized courses and modules in laser technology at any level. In particular Laser Safety training is one of the activities in which the Center is strongly active.

20 years transferring laser technology to industry

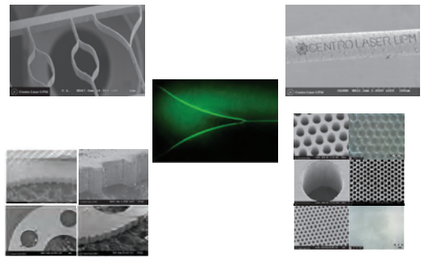
Cutting, welding, , LSP, heat treatments

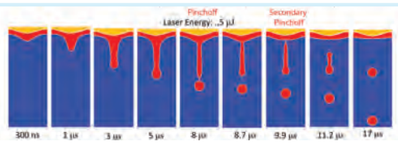


Laser processing for PV

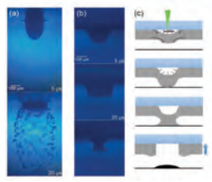


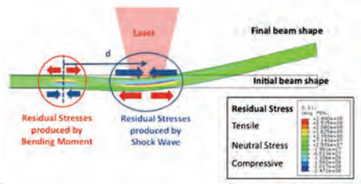
Micro and nanofabrication with lasers





Numerical modelling and fundamental studies.
Understanding laser-matter interaction:





In 2017 a service for external users of Laser Micromachining and Microsopy will be offered through UPM Scientific Servicies. Other facilities for mechanical (fatigue, tribology, corrosion) , electrical and optical testing of materials will be offered shortly

Micromachining Laser Stations

-AB 200- UV nano-picoseconds

Spectra Physics Vanguard
- ✓ Pulse width <10 ps
- ✓ 80 MHz
- ✓ 2.5 W

Spectra Physics Pulseo
- ✓ Pulse width <20 ns
- ✓ 1Hz-400 kHz
- ✓ 20 W @100 kHz

- ✓ DPSS Nd:YVO4
- ✓ Positioning system with 6 DOF
- ✓ Fix lens head
- ✓ Scanner head
- ✓ XYZ linear, rotation and tilt stages
- ✓ Vision system TTL

Applications
- ✓ 3D laser micromachining
- ✓ Microfluidics structures fabrication
- ✓ Surface modification
- ✓ Selective laser ablation
- ✓ Cleaving of Silicon wafers
- ✓ Photovoltaic industry

Tested Materials
- ✓ Polymers
- ✓ Metals
- ✓ Glasses
- ✓ Thin Film Structures
- ✓ Ceramics

-ML 100- UV nanoseconds

Excimer ATL Laser Lasertechnik SP300i
- ✓ KrF excimer 248 nm
- ✓ Pulse width ~7 ns
- ✓ 300 Hz
- ✓ 5W @ 300 Hz
- ✓ Mask projection

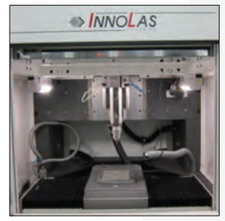
Spectra Physics HIPPO
- ✓ DPSS Nd:YVO4 355 nm
- ✓ Pulse width ~15 ns
- ✓ 15-300 kHz
- ✓ 5 W @ 50 kHz
- ✓ Fix lens head with processing gas

- ✓ XYZ linear, rotation and tilt stages
- ✓ Vision system TTL

Applications
- ✓ 3D laser micromachining
- ✓ Selective laser ablation
- ✓ Microcutting

Tested Materials
- ✓ Polymers
- ✓ Metals
- ✓ Glasses
- ✓ Thin Film Structures
- ✓ Photonic Crystals
- ✓ Ceramics

-INNOLAS Lumera Superapid- picoseconds
- ✓ DPSS Nd:YVO4 1064 nm/ 532 nm/ 355 nm
- ✓ Pulse width ~8 ps
- ✓ 18W @1064 nm
- ✓ 8W @ 532 nm
- ✓ 4W @ 355 nm
- ✓ Fixed lens head with processing gas
- ✓ Scanner head
- ✓ XYZ stage



Applications
- ✓ Thin Film Ablation
- ✓ Surface Texturing
- ✓ Laser Scribing, cutting and Drilling
- ✓ Photovoltaic industry
- ✓ Flex electronics

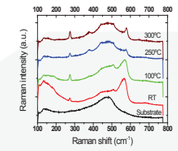
Tested Materials
- ✓ C-Si
- ✓ Thin Films
- ✓ Metals
- ✓ Polymers

Microscopy Facilities

Raman Spectroscopy

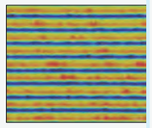
Study and **characterization of microestructured materials.**

Raman Microscopy Renishaw inVía
- ✓ Ar ion laser. Excitation wavelength: 514.5 nm
- ✓ Objectives: 5X, 20X, 50X, 100X
- ✓ Resolution XY: 1µm

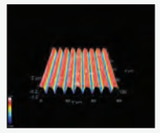


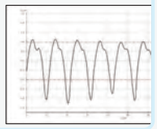
Confocal Microscopy

Allows the acquisition of optical sections that generate 3D images of the **morphology** of the sample. This capability is useful for measuring **surface profiles**.



Microscope Leica DCM 3D
- ✓ Confocal objectives: 10X, 20X, 50X 100X
- ✓ Interferometry objective: 50X mirau

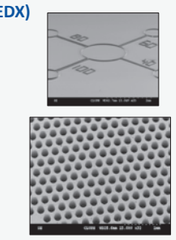




Scanning Electron Microscopy (SEM-EDX)

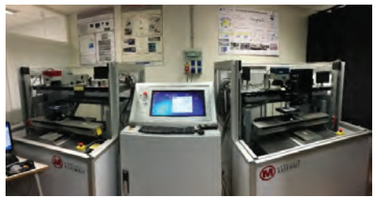
Hitachi S-3000 N

The signals that derive from electron-sample reveal information about **morphology, chemical composition, and crystalline structure**. Using EDS is useful in qualitatively or semi-quantitatively determining chemical compositions.

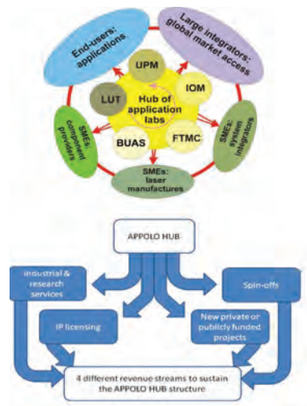


Laser Centre UPM is reference lab in Appolo's HUB: A disruptive european innitiative for equipment and process asessment in laser applications born under FP7 Appolo project

appolo
Hub of Application Laboratories for Equipment Assessment in Laser Based Manufacturing



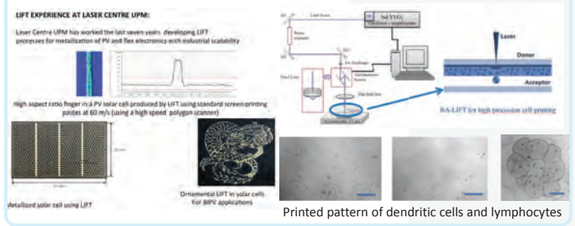
Facilities at Laser Centre UPM for equipment assesment include full equiped test benches specifically designed for laser processing of materials



Laser Direct Write of materials: a game changing technology

Printing metals for PV and flex electronics

Printing cells for life



Printed pattern of dendritic cells and lymphocytes

Start-up incorporated from Laser Centre UPM

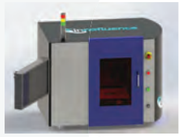
2nd VI EDITION ACTUA UPM (2009)

www.biod.es

WINNER XII EDITION ACTUA UPM (2015)

innofluence

Laser systems for material transfer in bioengineering



www.innofluence.es

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UPM Research Group on Laser Engineering and Applications

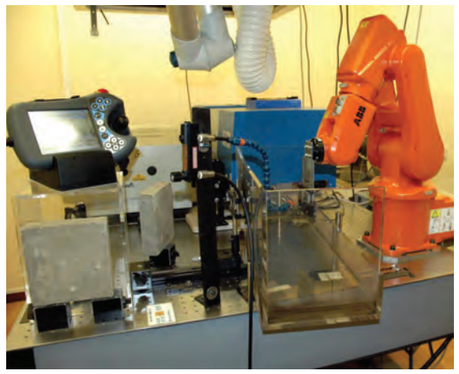
GRIAL-UPM
INGENIERÍA Y APLICACIONES DEL LÁSER

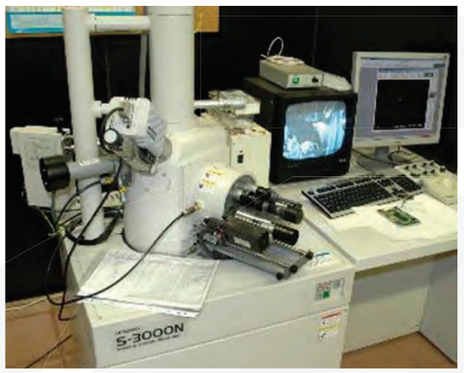
CENTRO LÁSER
UNIVERSIDAD POLITÉCNICA DE MADRID

POLITÉCNICA

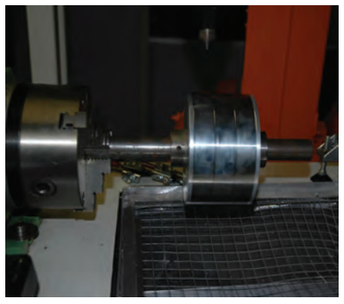
jlocana@etsii.upm.es;
http://www.upm.es/observatorio/vi/index.jsp?pageac=grupo.jsp&idGrupo=226

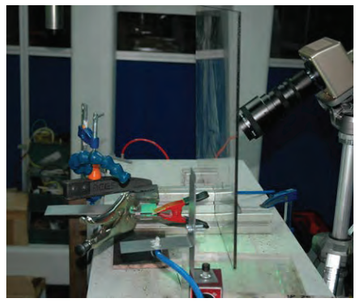
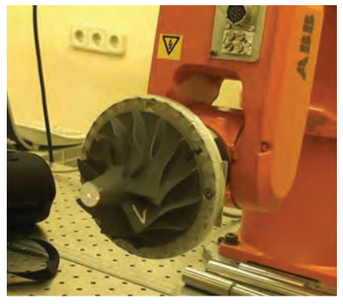
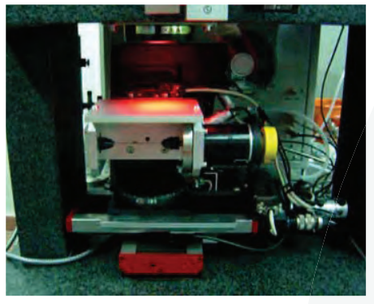
Main R&D Facilities:

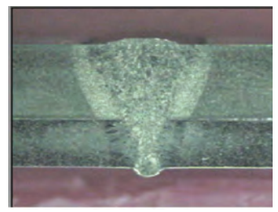
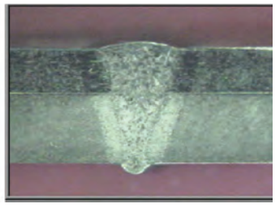
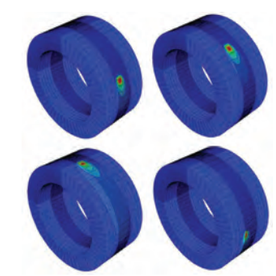


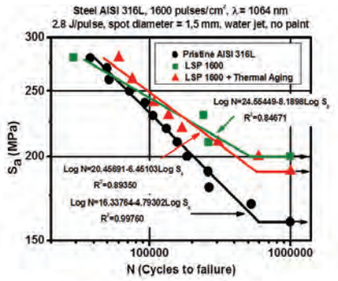
Representative Laser Processing Developments:

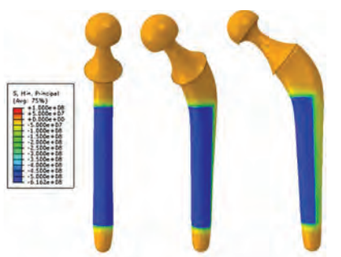
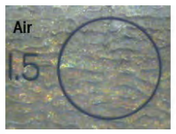


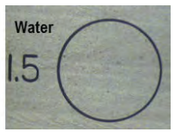




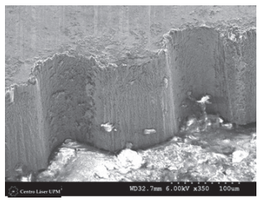
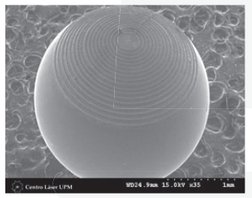
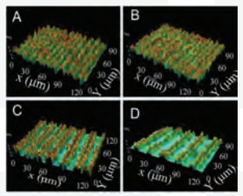
Representative R&D Results:

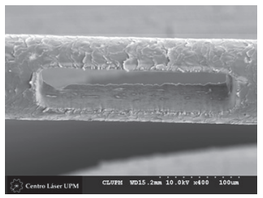
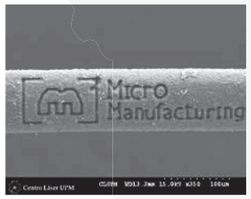




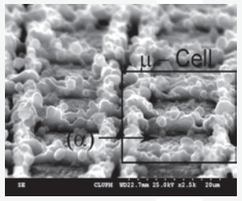


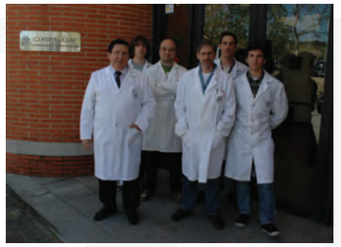








Grupo de Investigación en Manufactura Avanzada con Láser
Advanced Laser Based Manufacturing

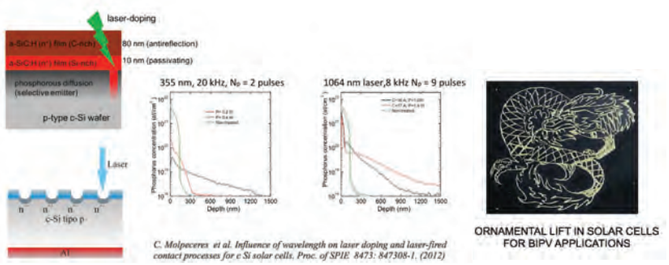
gi.mal@upm.es, http://www.upmlaser.upm.es

Presentation

- UPM Advanced Laser Based Manufacturing Research Group focus on the development and industrial transfer of advanced process using state-of-the-art pulsed laser sources and irradiation systems. The group develops its activity at UPM Laser Centre (www.upmlaser.upm.es) CENTRO LÁSER
- With a wide experience in micro and nanofabrication applications using laser technology, the group has current activity in strategic industrial sectors like energy (specially photovoltaics), aerospace, electronics, automotive, biotechnology, regenerative medicine, etc.
- Some members of the group collaborate in frontier problems in physics, like quantum optics and quantum computation

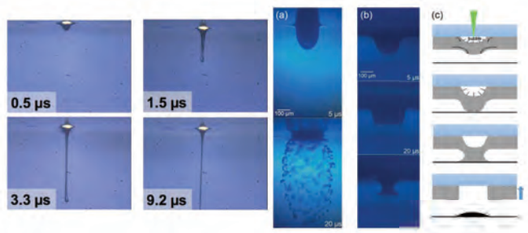
R&D activity examples

An international reference in laser process for PV industry: more than 10 years helping green energies development



In collaboration with:

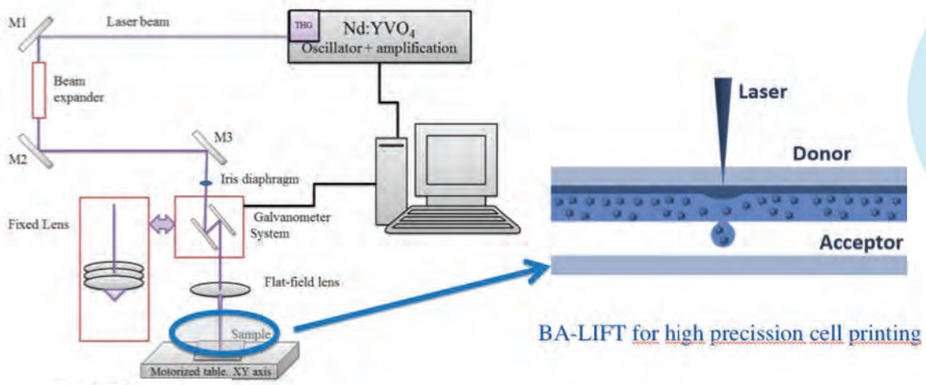
Fundamental studies in laser-based processes

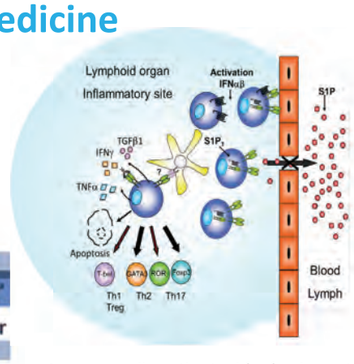


The group has an important experience in fundamental research and modelling of laser-matter Interaction processes. This group of images shows high speed imaging of Laser Induced Forward Transfer processes. In collaboration with

PRINCETON UNIVERSITY

What's new: Laser Direct Write techniques for biomedicine

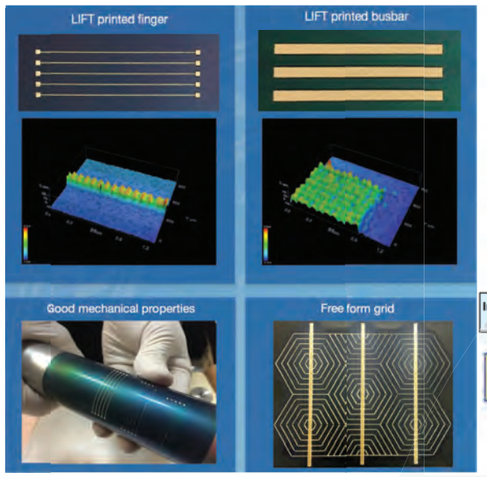


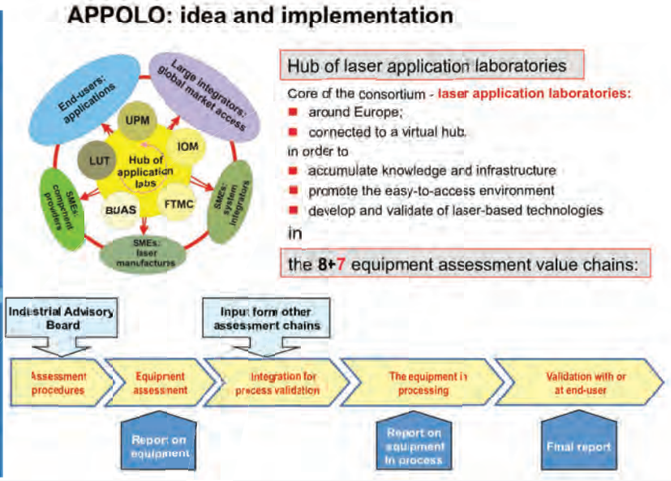


Lasers as a disruptive tool for fundamental studies in immunology.
In collaboration with: Instituto de Salud Carlos III

FP7 APPOLO Project: filling the gap between equipment suppliers and end users in laser technology

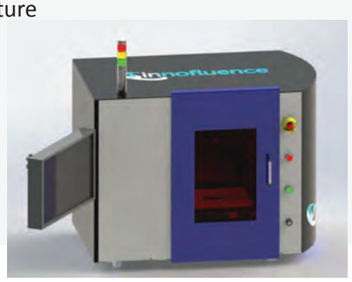
Our group is responsible of UPM participation in FP7 Appolo project, a disruprive project in laser technology to fill the gap between laser equipment suppliers and end users in different industrial strategic sectors for Europe. UPM focus its activity on new competitive metallization techniques for PV and flex electronics using ultrafast laser technology, together new laser processes for thin film PV based on CIGS and Perovskites





Entrepreneurship: from lab to society…and the winner is…

Members of our group are promoters and founders of Innofluence (www.innofluence.es) winner of the Actúa UPM competition in its XII edition. Business model is based in the development of Laser based machines for tissue engineering and cell culture



innofluence

THE GROUP


Cristina Muñoz


Andrés Márquez


PhD. David Canteli


PhD. David Muñoz


Assistant Prof. Sara Lauzurica


Associate Prof. Luis Seidel


Associate Prof. Miguel Morales


Associate Prof. José M. Díaz de la Cruz


Full Prof. Group Leader Carlos Molpeceres

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Mecánica

CENTRO DE MODELADO INGENIERIA MECANICA

UNIVERSIDAD POLITÉCNICA MADRID

POLITÉCNICA

Presentation

CEMIM is part of the Foundation for the Promotion of Industrial Innovations (F2I2) and it's closely related to the Department of Mechanical Engineering of the Technical University of Madrid (UPM).

The main goal of CEMIM is to promote the transfer of knowledge between the university and industry levels i.e. the application of research results to industry.

The office staff is composed by professors of the Department, PhDs and senior and junior researchers. The academic training is also a primary goal supervising several PhD Thesis, Master Theses (TFM) and Bachelor Theses (TFG).

CEMIM participates in many projects from a wide range of fields. The main works can be classified in:

- Railway aerodynamics
- Vibration and acoustic
- Numerical Models for Structural Analysis
- Tunnel ventilation

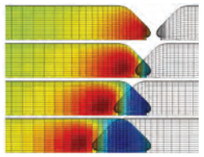
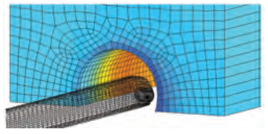
The CEMIM participation includes different project phases like initiation, measurements, planning, design and control during the execution.

Understanding ⇨ Interpretation ⇨ Developing ⇨ Validation

Initital measurements ⇨ Numerical simulation and design ⇨ Verification test

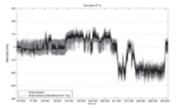
Railway aerodynamics

- **Estimation of pressure variations caused by trains traveling in open air or in tunnel**

- **Development of a measurement system and in-situ test**



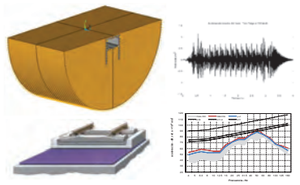



High speed train head wave measurement

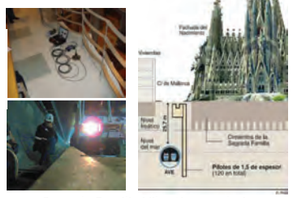
Air flow measurements at the bogies

Vibrations and Acoustics

- **Noise and vibration problems related to road and railway traffic**



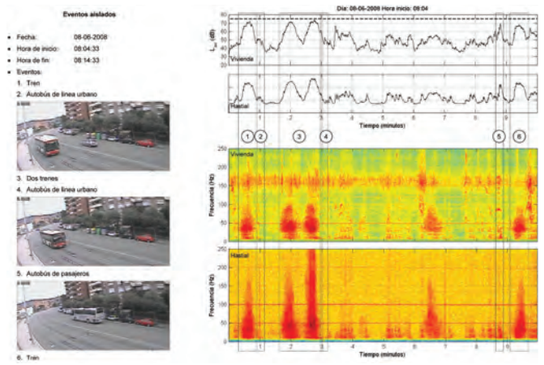
Numerical vibration prediction and isolation design



Sagrada Familia Vibration analysis
In-situ test and vibration prediction.

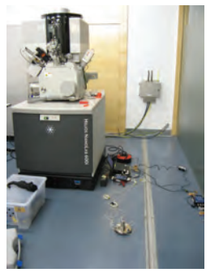
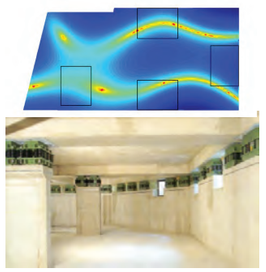
3D noise Map of head shaft of Metro North (Dublin)

Acoustic barrier verification measurements



Identification of vibration sources inside a residential building

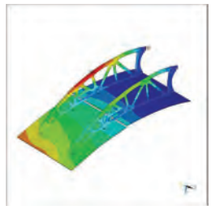
- **Isolation design**

IMDEA Materials (Madrid). Isolation of microscopy room

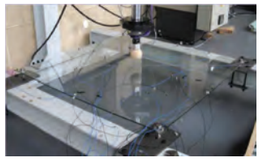
Numerical models for structural analysis

- **Optimization of structural designs**

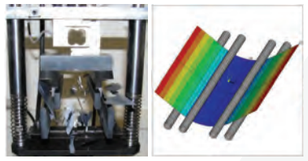



Design of the solar collector structure

- **Nonlinear analysis**

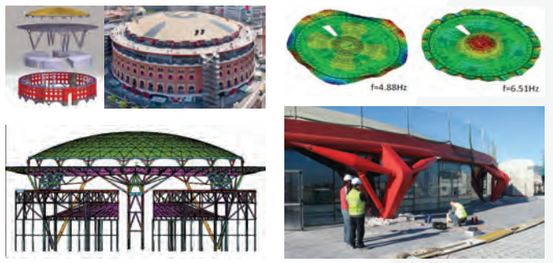


Mechanical characterization of viscoelastic laminated glass



Mechanical characterization of crystalline silicon wafers

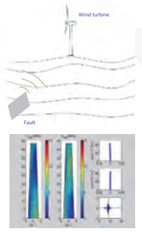
- **Structural and soil dynamics**



Dynamic characterization of the dish (upper light structure) and vibration isolation caused by human activity. Centro Comercial "Las Arenas" (Barcelona)

- **Earthquake Engineering**

Bridge seismic isolation design

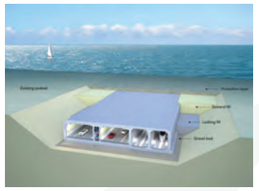
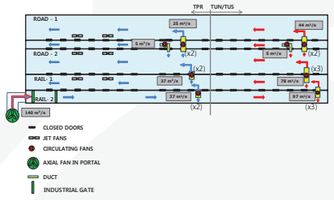


Soil-structure interaction and seismic response

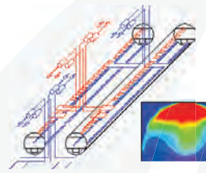
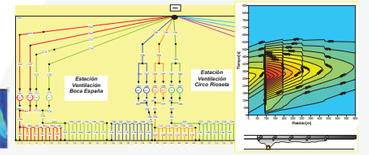
Seismic analysis of masonry infill walls (Lorca earthquake)

Tunnel ventilation

- **Coordination and consultation on tunnel ventilation and fire safety during design, execution and operation**

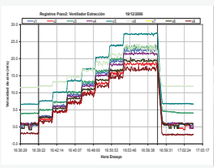



Design of the ventilation system of an underwater tunnel (Denmark)

Design of the ventilation system of the largest road tunnel in Spain (Somport)

- **Planning and execution of verification tests**


Test of the ventilation system in different tunnels (Somport, Vielha, M30)

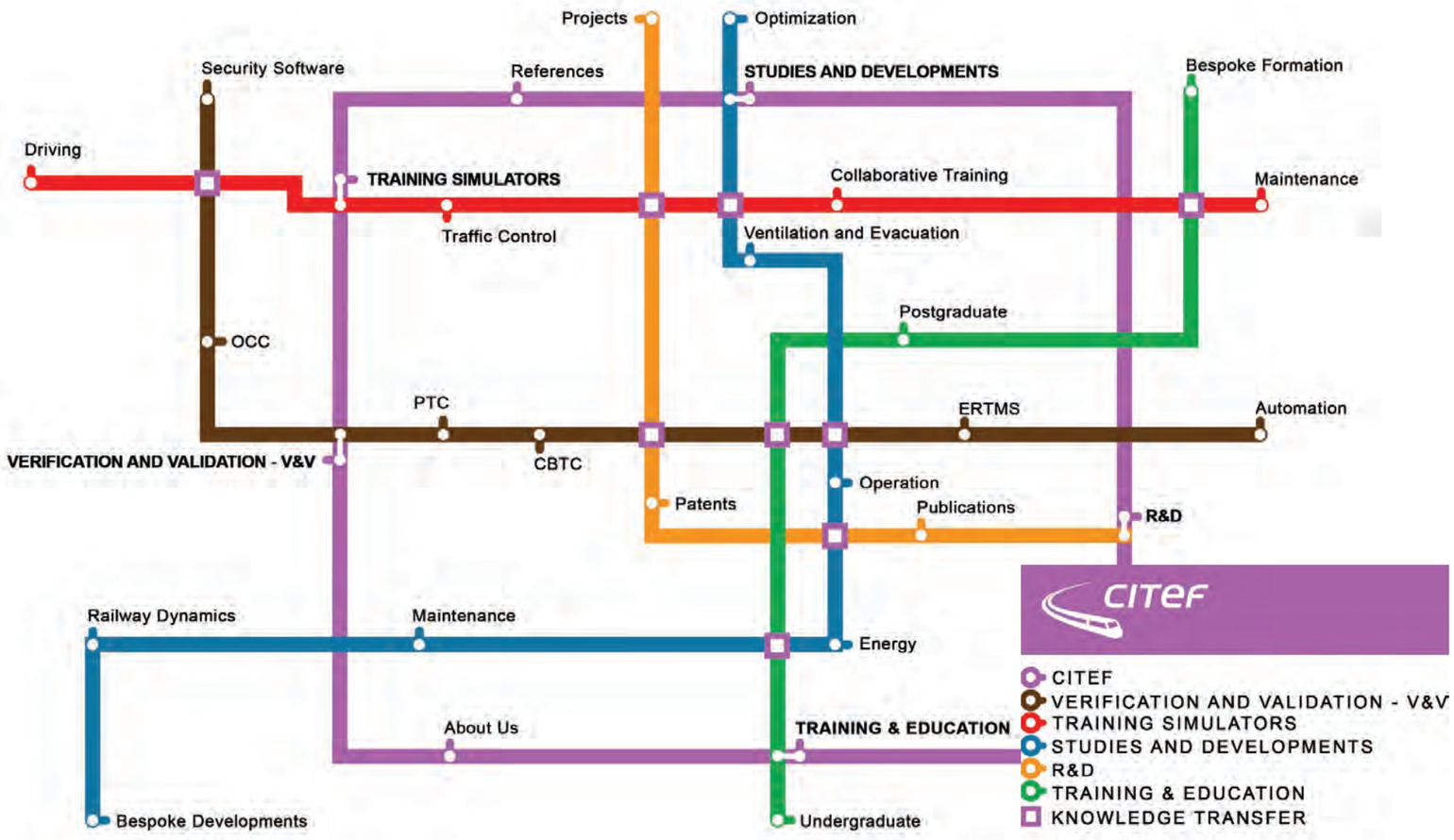
- **Coordination, supervision and participation in large scale fire tests**




Fire simulation test

Verification of a water-mist system

- **Other consulting activities:**
  - **Risk analysis**
  - **Development and specification of control algorithms for the tunnel ventilation**
  - **Training of tunnel operation staff**



CITEF develops innovative services and products in the railway sector:

Verification and Validation -V&V

- Methodology development and application
- OCC
- ERTMS / CBTC / PTC
- Automation
- Safety Software Development

R&D

- National & European Projects
- Patents
- Publications

Training Simulators

- Driving
- Traffic Control
- Collaborative Training
- Maintenance

Studies and Developments

- Railway Dynamics
- Ventilation and Evacuation
- Operation
- Power and Energy Consumption
- Operation and Maintenance Improvements
- Bespoke Developments

CITEF is a fully independent entity that uses a client-partner model to collaborate with the majority of the rail companies:

- Rail and Metro Operators
- Infrastructure Administrators
- Public Authorities
- Rolling Stock Manufacturers
- Manufacturers of Signalling Systems
- Manufacturers of Communication and Integration Systems
- Manufacturers of Railway Electrification Systems
- Civil Construction Companies
- Engineering and Consultancy Groups

CITEF's activity has a clear international scope. South America and Europe are the main areas of our activity, which in recent years has expanded to Asia:

Portugal, United Kingdom, Germany, Italy, Turkey, Bulgaria, Australia, Nueva Zeeland, Japan, USA, Mexico, Panama, Venezuela, Chile, Argentina, Egypt, Russia, Brazil, Singapore, China, Israel, Peru, Ecuador, Colombia, India, Denmark, …

BIOENGINEERING AND MATERIALS (BIO-MAT)

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http://www.upm.es/observatorio/vi/index.jsp?pageac=grupo.jsp&idGrupo=222

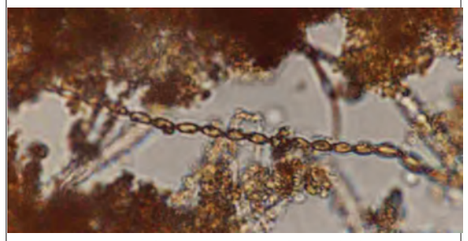
Research lines and coordinators: 1) Biofilms, biodeterioration and microbial corrosion (Diego A. Moreno); 2) Biodegradation and bioremediation (Ana M. García); 3) Nanotechnology of polymers and biopolymers (Mohammed Naffakh); 4) Industrial material behavior (José M. Ruiz-Román); 5) Sintered and new materials (Luis E. Cambronero); 6) Molecular microbiology and biotechnology (Andrés Núñez); 7) Industrial enzymology (M. Ascensión Fernández)

MICROBIOLOGICALLY INFLUENCED CORROSION OF INDUSTRIAL MATERIALS

Studies on Microbiologically Influenced Corrosion (MIC) have been developed as of the second half of the 20th century. MIC refers to the corrosion caused by microorganisms of metallic materials used by the industry such as: carbon and stainless steels, copper and its alloys, aluminium and its alloys, as well as titanium. Different terms are frequently used to describe MIC, for example, microbial corrosion or biocorrosion.

MIC costs are very important from an economic point of view. It is estimated that 10-20% of all corrosion damage of metals is caused by MIC. The cost of corrosion corresponds to 3-4% of the Gross Domestic Product (GDP), thus MIC costs amount to around 0.3-0.8% GDP. The main industries affected are **petrochemical** and **power (electric and nuclear)**, but industries such as **pulp and paper** or **waste-treatment** are also affected.

MIC in a pipeline of biogas in a waste-treatment plant.



Light micrograph of *Gallionella*, the most important iron-oxidising bacterium forming tubercles in steels, showing helically twisted ferric hydroxides.

References

J.R. Ibars, D.A. Moreno, C. Ranninger. Microbial corrosion of stainless steels. *Microbiología* 1992, 8, 63-75.

J.R. Ibars, J.L. Polo, D.A. Moreno, C. Ranninger, J.M. Bastidas. An impedance study on admiralty brass dezincification originated by Microbiologically Influenced Corrosion. *Biotechnology and Bioengineering* 2004, 87, 856-862.

D.A. Moreno, E. Cano, J.R. Ibars, J.L. Polo, F. Montero, J.M. Bastidas. Initial stages of microbiologically influenced tarnishing on titanium after 20 months of immersion in freshwater. *Applied Microbiology and Biotechnology* 2004, 64, 593-598.

BIODETERIORATION OF CULTURAL HERITAGE: CONSERVATION AND PREVENTION

The **Historical and Cultural Heritage** includes all property, both tangible and intangible, accumulated over time. The protection of intangible heritage (language, customs, music, etc.) is very vulnerable because of its ephemeral nature. The tangible heritage (monuments, buildings, manuscripts, documents, photographs) comprises a wide range of highly heterogeneous materials: stone, paper, wood, metals, polymers. All these materials have a natural tendency to deteriorate. In addition, living organisms, especially microorganisms, are able to grow on these materials modifying their properties and contributing to their biodeterioration. Knowledge of these biodeterioration processes is what enables the development of strategies for the conservation and prevention of the tangible heritage in order to extend its life and preserve it for posterity. Regarding the Cultural Heritage, the BIO-MAT Group characterize the materials, identify the microorganisms and study the biodeterioration mechanisms to establish the most appropriate measures of treatment, prevention and control.

We have studied the biodeterioration of **building and monuments** as The Lions Fountain at the Alhambra Palace (Granada, Spain) and the recommendations we made to the Council of the Alhambra were fulfilled, which led to the complete restoration of the fountain.

The Lions Fountain at the Alhambra Palace before restoration.

We also study different **paintings in paleolithic caves** such as Covalanas and La Haza (Ramales de la Victoria, Cantabria) and the Cave of Maltravieso (Cáceres) are some good examples of the priceless heritage that must be preserved for future generations. Our studies of molecular biology in these unique sites led to identify the main types of bacteria and fungi involved in the biodeterioration process.

Recently, we have analyzed the biodeterioration state of films from the Cuban Institute for **Cinematographic Industry and Arts** was evaluated. A significant fungal colonization was found on both sides of the films mainly from *Aspergillus* sp. and *Cladosporium* sp., which were still alive so the films under study were at risk of further deterioration due to the storage under inappropriate conditions.

References

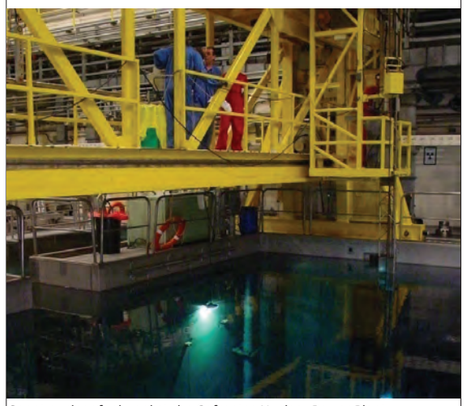
M.I. Sarró, A.M. García, V.M. Rivalta, D.A. Moreno, I. Arroyo. Biodeterioration of the Lions Fountain at the Alhambra Palace, Granada (Spain). *Building and Environment* 2006, 41, 1811-1820.

P.S. Guiamet, V. Rosato, S. Gómez de Saravia, A.M. García, D.A. Moreno. Biofouling of crypts of historical and architectural interest at La Plata Cemetery (Argentina*). Journal of Cultural Heritage* 2012, 13, 339-344.

I. Vivar, S. Borrego, G. Ellis, D.A. Moreno, A.M. García. Fungal biodeterioration of color cinematographic films of the cultural heritage of Cuba. *International Biodeterioration and Biodegradation* 2013, 84, 372-380.

BIOREMEDIATION OF RADIOACTIVE WATER IN NUCLEAR POWER PLANTS

The existence of microorganisms in spent nuclear fuel pools has been demonstrated recently in nuclear power plants by using conventional microbial techniques. Subsequent studies have revealed that those microorganisms are able to colonize the stainless steel pool walls forming biofilms. Moreover, it has been observed the ability of these biofilms to retain radionuclides, which suggests the possibility of its use for radioactive water decontamination purposes. Our research group develops a decontamination system on a pilot scale, in order to assess whether the process is scalable to an industrial level. Thus, a bioreactor was designed and manufactured, both compatible with seismic and radiation protection standards in the controlled zone of a nuclear plant. This bioreactor was installed in the Cofrentes Nuclear Power Plant (Valencia) next to the spent nuclear fuel pools and preceding (upstream) ion exchange resins. This configuration allowed the bioreactor to receive water directly from the pools allowing *in situ* analysis of radiation removal. We analyzed the microbial biofilms biodiversity by using molecular biology techniques such as cloning, and identified radioresistant microorganisms belong to the phylogenetic groups *Alpha-proteobacteria*, *Gamma-proteobacteria*, *Actinobacteria, Deinococcus-Thermus* and *Bacteroidetes*. Biofilms have essentially retained activation radionuclides. Sometimes the sum of Co-60 and Mn-54 reached 98%. Cr-51, Co-58, Fe-59 Zn-65 and Zr-95 have also been retained. It has been assessed that the scalable process can be economically profitable. These findings are very interesting for the **nuclear power industry**.



Spent nuclear fuel pool at the Cofrentes Nuclear Power Plant (Cofrentes, Valencia, Spain).

References

E. Chicote, D.A. Moreno, A.M. García, M.I. Sarró, P.I. Lorenzo, F. Montero. Biofouling on the walls of a spent nuclear fuel pool with radioactive ultrapure water. *Biofouling* 2004, 1, 35-42.

M.I. Sarró, A.M. García, D.A. Moreno. Biofilm formation in spent nuclear fuel pools and bioremediation of radioactive water. *International Microbiology* 2005, 8, 223-230.

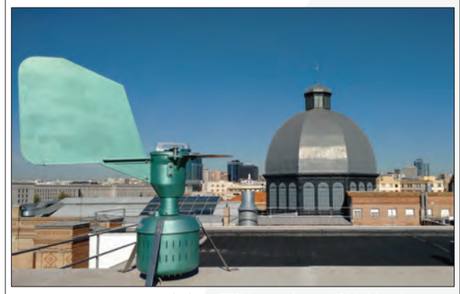
M.I. Sarró, A.M. García, D.A. Moreno, F. Montero. Development and characterization of biofilms on stainless steel and titanium in spent nuclear fuel pools. *Journal of Industrial and Biotechnology* 2007, 6, 433-441.

J.A. Belinchón. *Diseño y evaluación de un procedimiento on-line para la biorremediación de aguas radiactivas en centrales nucleares.* 2016. PhD Thesis.

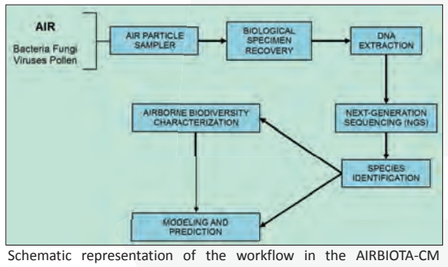
BIOLOGICAL MONITORING OF URBAN AIRBORNE PARTICLES

Microorganisms are ubiquitous and the air acts as a means of transport for many of them: viruses, bacteria, fungi and pollen grains. This aerobiota interacts with buildings, plants, animals and even humans, being responsible for biodegradation of the built heritage, plages in plantations, allergy and airborne diseases such as flu, pneumonia or legionellosis. Although chemical air pollution (CO_2, SO_x, NO_x, O_3, PM_{10} and $PM_{2.5}$ ...) is well-characterized in the urban atmosphere to keep the levels of pollutants under strict control, less is known about microbial communities which are present in the air of outdoor spaces.

This research line, within the AIRBIOTA-CM Program, analyzes the changes in microbial airborne communities in Madrid at different seasons, places and heights. Unlike traditional methods used in environmental studies of microorganisms, we apply new molecular biology approaches, such as Next-Generation DNA Sequencing (NGS) or Metagenomics. This technique allows to identify any organism from complex samples by analyzing the DNA, which is characteristic for each living being, including viruses. The results, with relevance for both **environmental and health** studies, will provide new methods for monitoring and modeling innocuous and pathogenic microorganisms present in urban spaces.



Spore sampler in the roof of the ETSI Industriales (UPM, Madrid).



Schematic representation of the workflow in the AIRBIOTA-CM Program.

References

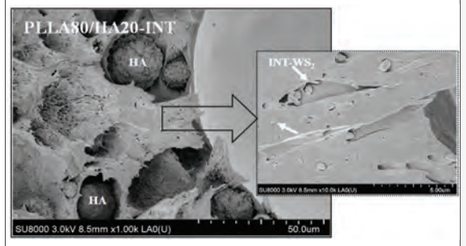
A. Núñez, G. Amo de Paz, A. Rastrojo, A.M. García, A. Alcamí, A.M. Gutiérrez-Bustillo, D.A. Moreno. Monitoring of airborne biological particle in outdoor atmosphere. Part 1: Importance, variability and ratios. *International Microbiology* 2016, 1, 1-13.

A. Núñez, G. Amo de Paz, A. Rastrojo, A.M. García, A. Alcamí, A.M. Gutiérrez-Bustillo, D.A. Moreno. Monitoring of airborne biological particles in outdoor atmosphere. Part 2. Metagenomics applied to urban environments. *International Microbiology* 2016, 2, 69-80.

NANOTECHNOLOGY OF POLYMERS AND BIOPOLYMERS

In recent years, special attention has been given to the benefits of polymer nanocomposite technology to improve the inherent properties of biopolymers. In this respect, inorganic transition metal dichalcogenide materials (TMDCs), such as tungsten and molybdenum disulfides (WS_2 and MoS_2), are of interest to the scientific community because of their unique layered structure and functional properties, with nano-sized particles tending to exhibit a different set of properties compared to the bulk forms. TMDCs nanostructures can be zero-dimensional (0-D) (nanoparticles), one-dimensional (1-D) (nanotubes) or two-dimensional (2-D) (nanosheets). In particular, the use of inorganic fullerene-like nanoparticles (IF-WS_2) and nanotubes (INT-WS_2)has resulted in significant improvement in thermal, mechanical, physical, and surface properties of polymers and polymer matrix composite resins.

The surprising properties of these layered metal dichalcogenides such as high impact resistance and superior tribological behavior open up a wide variety of opportunities for applications in, for example, the **automotive and aerospace industries, electronics and medical technology** and, more particularly, in the field of polymer nanocomposites. Moreover, INT(IF)-WS_2 are low-cost, environmentally friendly and biocompatible nanofillers since they possess a much lower cytotoxicity than other nanoparticles, such as silica or carbon black. Promising results have also been recently found with regard to the biocompatibility of INT(IF)–WS_2 with salivary gland cells, rendering them attractive for several technological and **biomedical applications**. In particular, an exciting opportunity exists for research in the area of nanocomposite polymer biomaterials.



Low and high magnification SEM images of poly(L-lactic acid)(PLLA)/hydroxyapatite(HA)/INT-WS_2 nanocomposites.

References

M. Naffakh, A.M. Díez-Pascual, C. Marco, G. Ellis, M.A. Gómez-Fatou. Opportunities and challenges in the use of inorganic fullerene-like nanoparticles to produce advanced polymer nanocomposites. *Progress in Polymer Science* 2013, 8, 1163-1231.

M. Naffakh, C. Marco, G. Ellis. Development of novel melt-processable biopolymer nanocomposites based on poly(L-lactic acid) and WS_2 inorganic nanotubes. *CrystEngComm* 2014, 16, 5062-5072.

M. Naffakh, A.M. Díez-Pascual. Nanocomposite biomaterials based on poly(ether-ether-ketone) (PEEK) and WS_2 inorganic nanotubes. *Journal of Materials Chemistry B* 2014, 2, 4509-4520.

M. Naffakh, A.M. Díez-Pascual. WS_2 inorganic nanotubes reinforced poly(L-lactic acid)/hydroxyapatite hybrid composite biomaterials. *RSC Advances* 2015, 5, 65514-65525.

Computational Statistics and Stochastic Modeling

http://www.etsii.upm.es/ingor/estadistica/

(Contact: jesus.juan@upm.es)

Main research areas

Consolidated Group with a broad knowledge of Applied Statistics:

Linear Models, Quality Control, Multivariate Analysis, Simulation Methods, Time Series, Bayesian Methods, Qualitative Data Analysis, Regression Trees

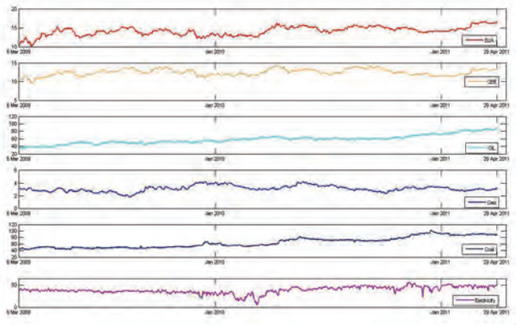
Collaboration with:

CSN
ENCE
Endesa
Iberdrola Renovables
Ministerio de Fomento
Ministerio de Industria
Red Eléctrica
Renfe
Unión Fenosa
VIESGO
Institute for Energy and Transport, European Commission
Repsol

Dimensionality reduction techniques for Multivariate time series models

Applications:

•Electricity prices in liberalized energy markets.
•Wind Power production
•Air quality data: Analysis of data from monitoring networks that measure concentrations of different pollutants. Concentration of pollutants.
•Evolution over time of scram rates in nuclear power plants.



Volatility modelling. Extraction of common and specific components in volatility

Applications:

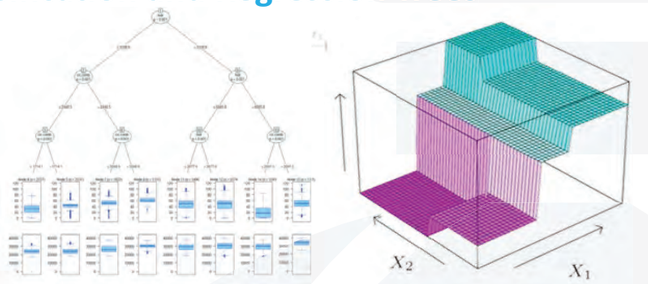
•Energy Markets (electricity prices, fossil fuel prices, and Carbon Emmission prices).

Data Mining: Models based on Classification and Regression Trees

CART, Random Forest, Bagging
BART (Bayesians)
Dynatree (Dynamic Bayesians)
Ctree Multivariate (Multivariate)

Applications:

- Modeling electric energy prices
- Analysis of sensitivity of computer codes



Econometric models for macro analysis of traffic accidents

- Estimation of ARIMA and structural dynamic models from data.
- Monte Carlo simulation for theoretical comparison of the models.
- Use of Bayesian methods with MCMC computational techniques.

Treatment of censored data

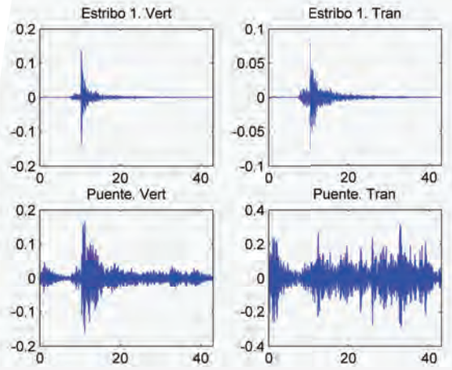
- Right Censorship
- Left Censorship
- Reliability

Applications:

- Equipment breaks in wind farms
- Applications to serious or terminal diseases

State space models and their estimation in the field of civil engineering

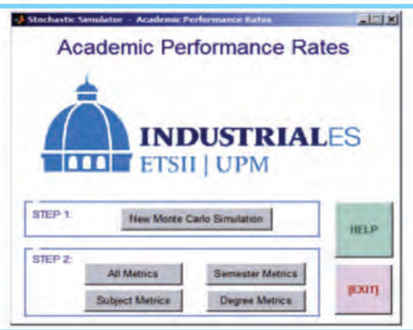
- Analysis of time series of vibration data recorded in civil engineering structures
- Estimation of state space models using the Expectation – Maximization algorithm
- Estimation of mechanical properties of bridges, buildings, …



Simulation of processes with stochastic components using the Monte Carlo Method

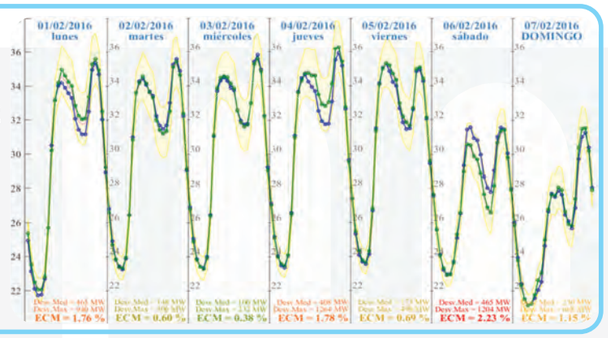
Applications:

- Vehicle safety and traffic. Transferability
- Comparison of models
- Academic performance
- Probabilistic security analysis



Forecasting electricity demand in Spain

- The developed model considers the effects of maximum/minimum temperature, non-working days, public holidays, time-change days, etc.
- The model developed is currently used to forecast the peninsular electricity demand.
- Twelve local models (Balearic and Canary Islands, Ceuta and Melilla) is being tested.



Wind Energy and Electrical Generation

carlos.veganzones@upm.es, www.dinel.upm.es/generacioneee.htm

Research Lines

- 1 Wind energy electricity generation systems
- 2 Ocean energy electricity generation systems
- 3 Integration of renewable energy in power systems, and micro-grids
- 4 Design, protection, diagnosis and monitoring of electrical machines
- 5 Electric vehicles and energy storage
- 6 Monitoring and control of electronic converters in electrical drives

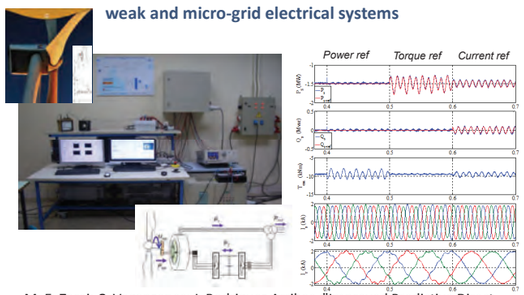
UPM asociated Departments

- Automatic Electrical and Electronics Engineering and Computer Department. (School of Industrial Engineering).
- Civil Engineering Department: Hydraulics, Energy and Environment. (School of Civil Engineering).

Coordination

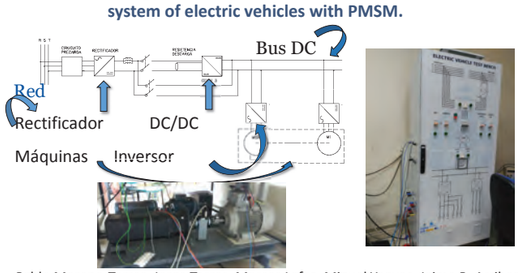
- Dr. Carlos Veganzones
- Dr. Sergio Martinez
- Dr. Jaime Rodríguez
- Dr. Francisco Blázquez
- Dr. Dionisio Ramírez
- Dr. Carlos Platero
- Dr. José Ángel Sánchez

Power Control of DFIG Wind Turbines in weak and micro-grid electrical systems



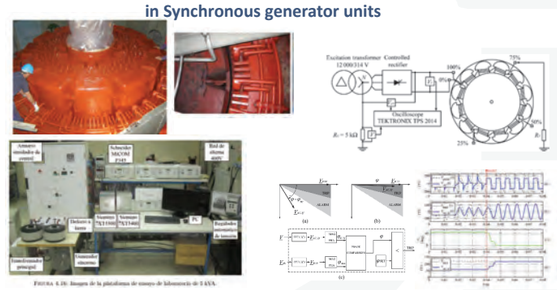
M. E. Zarei; C. Veganzones; J. Rodriguez Arribas, "Improved Predictive Direct Power Control of Doubly Fed Induction Generator during Unbalanced Grid Voltage Based on Four Vectors," in IEEE Journal of Emerging and Selected Topics in Power Electronics , vol.PP, no.99, pp.1-1 doi: 10.1109/JESTPE.2016.2611004

Energy efficiency improvements in the traction system of electric vehicles with PMSM.



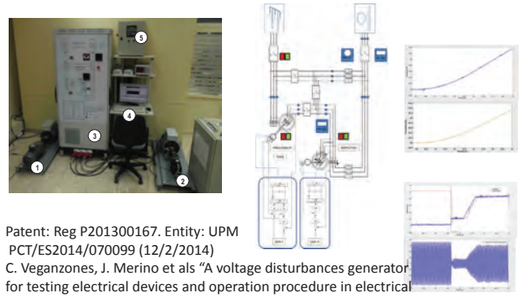
Pablo Moreno-Torres, Jorge Torres, Marcos Lafoz, Miguel Yeguas, Jaime R. Arribas. "Minimum Losses Point Tracking and Minimum Current Point Tracking in Interior PMSMs". EPE'16. ECCE Europe 18th European Conference on Power Electronics and Applications 5-9 September 2016, Karlsruhe (Germany). ISBN: 9789075815252 and CFP16850-USB.

Ground fault protection and detection in Synchronous generator units



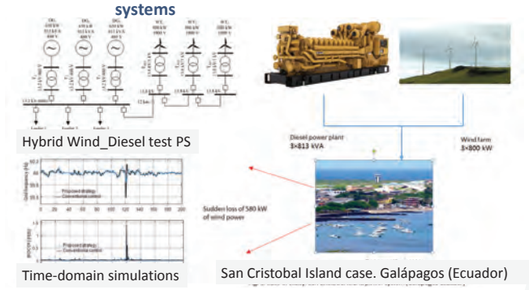
FR. Blánquez; CA. Platero; E. Rebollo; F. Blázquez "Novel Rotor Ground-Fault Detection Algorithm for Synchronous Machines With Static Excitation Based on Third-Harmonic Voltage-Phasor Comparison" IEEE Transactions on Industrial Electronics Year: 2016, Volume: 63, Issue: 4 Pp: 2548 - 2558, DOI: 10.1109/TIE.2015.2497214

Voltage disturbances prototype for testing electrical generators connected to microgrids



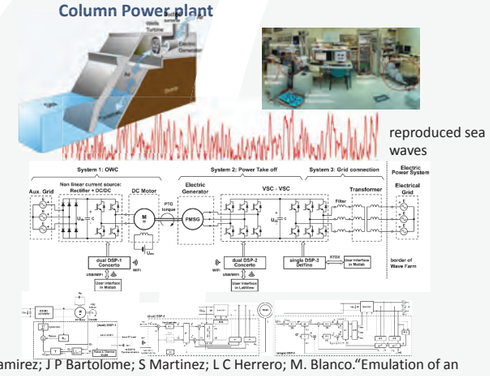
Patent: Reg P201300167. Entity: UPM
PCT/ES2014/070099 (12/2/2014)
C. Veganzones, J. Merino et als "A voltage disturbances generator for testing electrical devices and operation procedure in electrical network systems with distributed generation"

Frequency support provided by variable speed-wind turbines in weak power systems



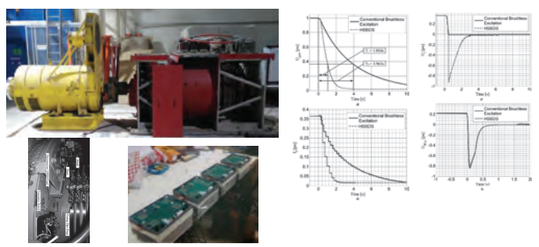
D. Ochoa and S. Martinez, "Fast-Frequency Response provided by DFIG-Wind Turbines and its impact on the grid," *IEEE Trans. Power Syst.*, vol. PP, no. 99, pp. 1–1, 2016. (DOI: 10.1109/TPWRS.2016.2636374).

Reproduction in the Lab of an Oscillating Water Column Power plant



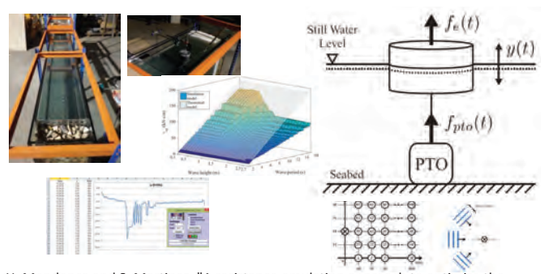
D. Ramirez; J P Bartolome; S Martinez; L C Herrero; M. Blanco."Emulation of an OWC Ocean Energy Plant With PMSG and Irregular Wave Model" IEEE Transactions on Sustainable Energy Year: 2015, Volume: 6, Issue: 4 Pages: 1515 - 1523

De-excitation system of brushless Synchronous Machines



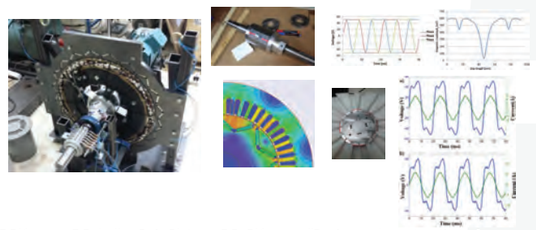
E. Rebollo; FR. Blánquez; CA. Platero; F Blázquez; M Redondo. "Improved high-speed de-excitation system for brushless synchronous machines tested on a 20 MVA hydro-generator. Year: 2015, Volume: 9, Issue: 6 pp: 405 - 411, DOI: 10.1049/iet-epa.2014.0313

Wave Energy harvesting Optimization. Prediction system in a wave farm



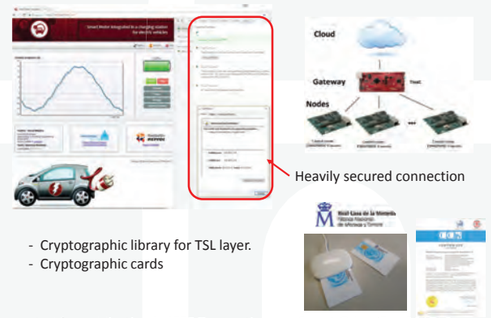
H. Mendonca and S. Martinez, "A resistance emulation approach to optimize the wave energy harvesting for a direct drive point absorber," in IEEE Transactions on Sustainable Energy, vol. 7, no. 1, pp. 3-11, Jan. 2016.doi: 0.1109/TSTE.2015.2466097

Laboratory Bench for Training on Diagnostics of Permanent Magnet Motors



F Blázquez; E Rebollo; C. A. Platero; F R. Blánquez "Design and construction of a laboratory bench system for the teaching and training of engineers on diagnostics of permanent magnet motors" 2015 IEEE 10th International Symposium on Diagnostics for Electrical Machines, Power Electronics and Drives (SDEMPED) pp: 131 - 137, DOI: 10.1109/DEMPED.2015.7303680

Secure control and communications in Smart Grids



- Cryptographic library for TSL layer.
- Cryptographic cards

Presented for publication in IEEE Transactions on Smart Grids (Feb 2017) D. Ramirez, Senior member IEEE, V. Ramirez FNMT-RCM, G. Venkataramanan, Senior member IEEE

Grupo de Investigación en Ingeniería de Calidad Alimentaria

crmonroy@etsii.upm.es

Dynamics of Spanish gas prices and Brent Oil effects. A quantitative approach

Objectives

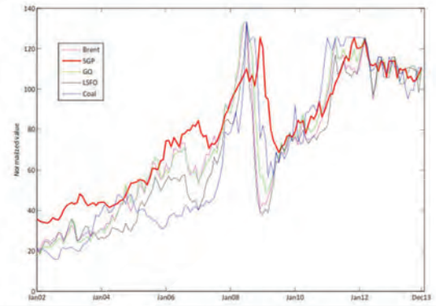
In competitive markets, with multiple sellers and buyers, prices are mostly driven by supply and demand with price itself providing signals to ensure market equilibrium. The case of Spain is a good example, where gas supply conditions comprising a substantial amount of long-term contracts together with limited connectivity with France, may explain the slower pace of implementation of a liquid gas hub in the country. Moreover, the fact that globally the relationship between natural gas and crude oil prices is not certainly transparent, not only because both commodities are rivals in production but also because gas markets are regionally segmented, raises questions about the view of steady state growth of natural gas prices.

The objective of the study is primarily to evaluate the underlying relationship between oil and natural gas in Spain and provide quantitative information on this relationship for a stated period of time. The selected period, 2002 – 2014 is a highly representative time window to also assess the progress of liberalization in the Spanish gas market. Furthermore the aim of the thesis is to assess the resilience of traditional oil-indexed structures and as a consequence to advance the degree of penetration of liquid hub pricing into Spain over the referred period. In this sense the study concentrates on two key areas providing insight on the oil-gas relationship. Firstly and similarly to financial asset prices, we analyse the scope for the order of integration of both series allowing for the possibility of structural breaks. The results will provide evidence and similarities about the true nature of the price series within an integrated unit root testing framework but also about whether significant changes - upwards or downwards - in the long run path of oil and natural gas series coincide. Secondly, the thesis examines the changing patterns of volatility in the oil and Spanish natural gas sectors. This property often manifests as volatility clustering and suggests that the conditional variance of the return series may not be constant. This time-varying property implies that shocks to the series affect volatility for several, if not many, periods into the future. Knowledge about the persistence of volatility can enable researchers to obtain more efficient parameter estimates, as persistence suggests that current volatility can be predicted.

Understanding gas price setting characteristics in Spain.

Currently, the majority of Spanish gas companies' long-term contracts for gas purchase are largely indexed to oil and oil products although indexation to other indices like NBP, Coal and even SMP can also be found. In this sense a thorough understanding of gas price dynamics is needed to understand potential influences and effects of other variables in gas prices, especially of oil and oil products. Descriptive statistics for all the variables selected are analysed, this possibly advancing a similar behaviour among these variables and gas prices. It is interesting to realize that in spite of a well-connected LNG market worldwide, Spanish gas prices might show very limited response to other than crude oil-related fundamentals.

Figure 1_ Oil, oil products and Coal prices vs. Spanish gas price



Beyond Smart Cities: Circular Economy and Demand-driven Innovations in Urban Sewage Management

The focus of this research is aimed at detecting fast track demand-driven innovations in wastewater management using real-time monitoring (sensing, detection, pollution control and prevention) in an urban context (smart cities) in order to control pollution components and sources (diffuse and punctual pollution) of urban sewage (chemical and biological).

This research will try to analyze matching types between demand-driven challenges and Key Enabling Technologies (KET, such as nanotechnology) and ICT solutions (sensors, big data, satellites, drones, among others). Real-time monitoring of wastewater is the first step to reuse water and to plan intelligent infrastructures (green infrastructure locations, reduction of urban sewage final treatments costs, high quality sustainable drainage systems) in smart cities, which is critical in an urban context and for water-dependant industries with a high pressure over water resources since they are the largest consumers.

Results of this research could help establish industry-smart city-water-tourism interactions in order to boost a circular and green economy which can lead to sustainable growth in cities creating highly skilled jobs and new sustainable business models.

Energy planning in isolated environments

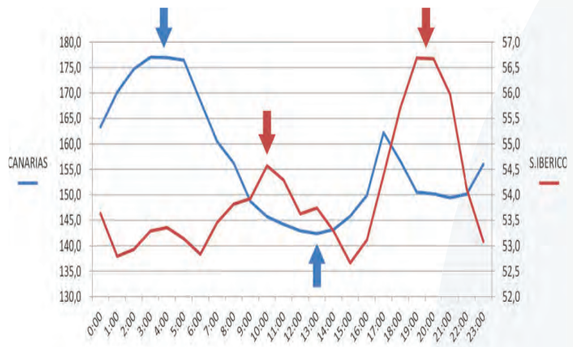
An Isolated Energy System is defined by a country's inability, due to smallness and/or remoteness, to interconnect with other electricity generators and consumers through a wider transmission grid outside its national borders.

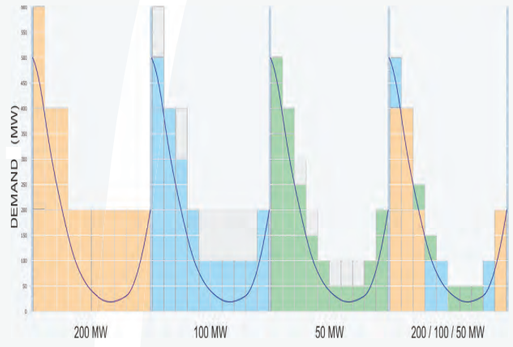
Small islands or Isolated Systems tend to have common problems related to fuel dependence and waste treatment. Our objective is to strategically design policies and procedures to reduce energy problems in these territories and improve waste management in a **circular economy**.

Large engines lack optimum performance when consumer demand for electricity is low. As a result, energy costs more to produce at night than during the day when the system is in higher demand.

Energy efficient solutions in the Canary Islands?

- ✓ Self-supplier of sustainable fuel.
- ✓ Electric grid improvement with the installation of small power plants in various grid points, which allows the installation of different technologies.
- ✓ Improve waste management at lower costs and landfill rehabilitation.
- ✓ Electricity generation, reduction of greenhouse gas emissions, and lower costs.





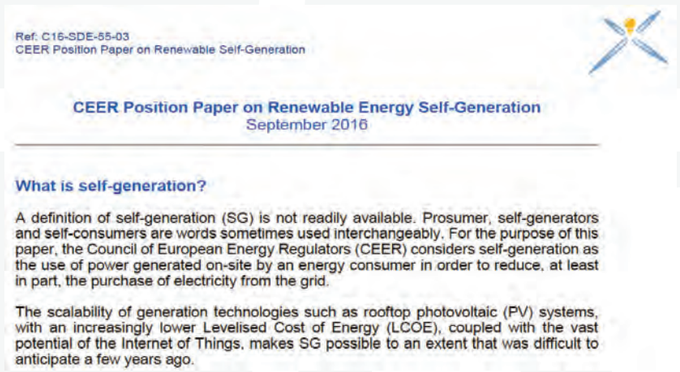
Regulatory proposals for the development of renewable energy self-consumption in Spain

COP22 called for political commitment to combat climate change by using low-carbon energy sources. The European Commission recognises that industrial and domestic sectors have the possibility of consuming their own electricity, due to the level of development and innovation of most Member States. The rise in electricity prices, together with the decrease in the cost of renewable generation technologies, results in estimations foreseeing up to a 75% increase of the self-consumption rate in European households. However, the lack of regulation on this issue at European level has derived in different regulations being approved across Member States. In Spain, Royal Decree 900/2015 has been considered too restrictive, in the sense of precluding the financial feasibility of self-consumption systems' deployment, whereas other European countries with poorer renewable energy resources are experiencing a higher growth in this field.

Research question

What regulatory approaches should be adopted in Spain in order to foster power self-consumption among domestic customers?

The objective is to analyse the current situation associated to power self-consumption both at European and national level, in order to develop regulatory proposals that help fostering its development and use among domestic customers in Spain, ensuring the economic feasibility of the power sector.



Ref: C16-SDE-55-03
CEER Position Paper on Renewable Self-Generation

CEER Position Paper on Renewable Energy Self-Generation
September 2016

What is self-generation?

A definition of self-generation (SG) is not readily available. Prosumer, self-generators and self-consumers are words sometimes used interchangeably. For the purpose of this paper, the Council of European Energy Regulators (CEER) considers self-generation as the use of power generated on-site by an energy consumer in order to reduce, at least in part, the purchase of electricity from the grid.

The scalability of generation technologies such as rooftop photovoltaic (PV) systems, with an increasingly lower Levelised Cost of Energy (LCOE), coupled with the vast potential of the Internet of Things, makes SG possible to an extent that was difficult to anticipate a few years ago.

Grupo de Investigación en Ingeniería de Máquinas

jlmunoz@etsii.upm.es, http://www.dim.etsii.upm.es

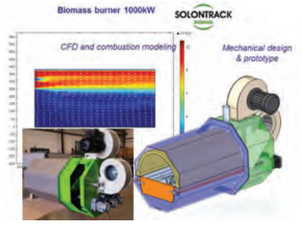
Introduction

UPM's Research Group in Machines Engineering was founded in 2007 and is devoted to research, innovation and teaching tasks in most fields of Mechanical Engineering and especially focused in the complete life-cycle of innovative machines and products. Areas including systematic machine and product development, performance optimization, design and modelling of advanced materials for machines and products, understanding and modeling complex contact phenomena and aspects linked to machines' and products' safety and maintenance are part of our daily activities. Three laboratories support our research, innovation and teaching activities: the UPM's Product Development Lab, the UPM's Machine Safety Lab and the UPM's Composite and Nanocomposite Materials Lab.

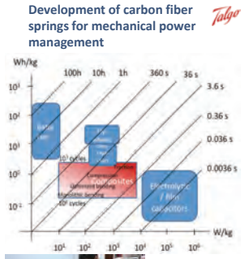
Currently we participate in 2 EU-funded proyects within Horizon 2020 (Tomax & Ubora), in 2 National competitive projects (Housses & Fuel Economy) and collaborate actively with enterprises such as: Repsol, Talgo, Abengoa, Grupo Cobra and with institutions such as: Industry Ministry of Spain, ENAC, AENOR, KNMF-KIT and Comunidades autónomas . We count with 4 PhD students and apply these research and innovation advances to the teaching – learning practice in more than 10 subjects from UPM's Mechanical Engineering Department, directing more than 25 MSc & Final Degree Theses per year.

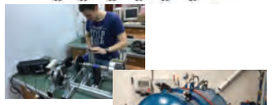
Machines Engineering & Product Development

Biomass burner 1000kW

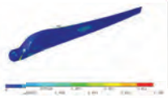


Development of carbon fiber springs for mechanical power management

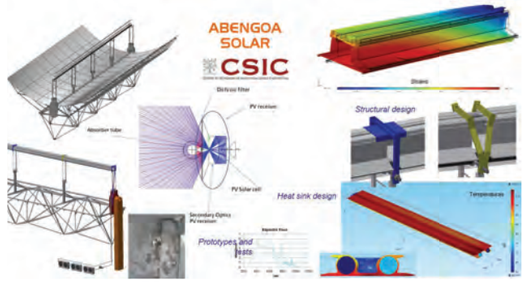




Design and "one shot" manufacturing of a 10m wind turbine blade

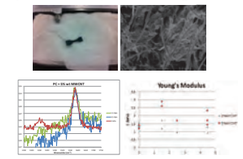


Hybrid solar generation system

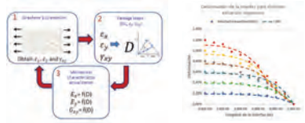


Advanced Materials: Design, Modelling and Manufacture

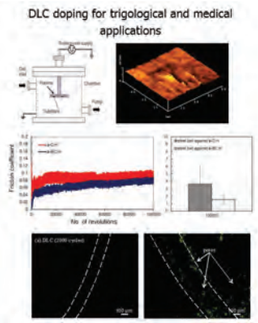
Enhancement of the interfacial properties in carbon polymer nanocomposites for fatigue life increase



Multiscale modeling of the interfacial properties of polymer carbon nanocomposites



DLC doping for trigological and medical applications

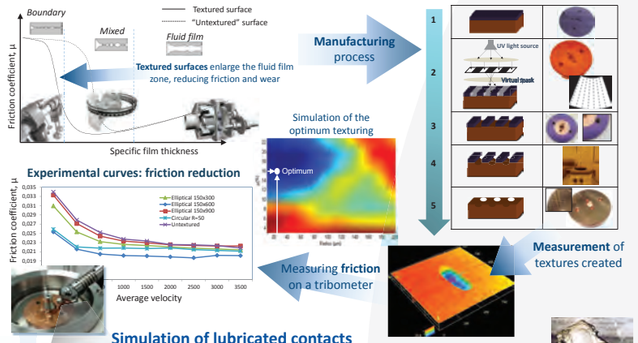


Success cases: tissue engineering scaffolds, microfluidic systems, metamaterials

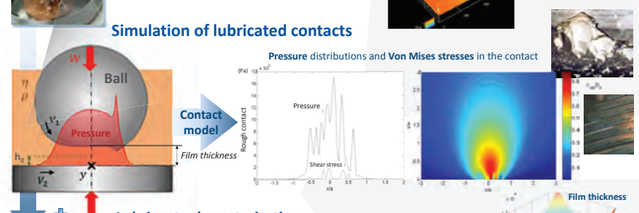
Complex geometries for improved performance and enhanced functionalities

Tribology: Complex contact phenomena

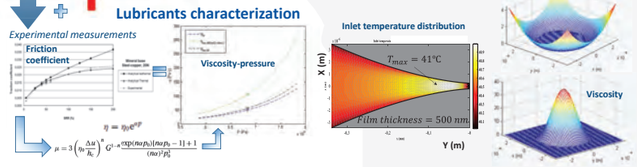
Friction optimization with surface texturing



Simulation of lubricated contacts

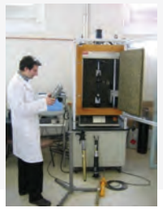


Lubricants characterization



Machine Safety & Maintenance

Mechanical (statical and dynamical), thermal and noise testing.
EU Directives and their application.
Elaboration of maintenance strategies and design for improved safety.



ENAC Entidad Nacional de Acreditación

GOBIERNO DE ESPAÑA · MINISTERIO DE ENERGÍA, TURISMO Y AGENDA DIGITAL

Comunidad de Madrid

AENOR

Grupo de Inv. Ingeniería de Organización y Logística

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http://www.upm.es/observatorio/vi/index.jsp?pageac=grupo.jsp&idGrupo=208

The research group use Operation Research methods such as Optimization and Simulation techniques, nevertheless some qualitative methods are also used for helping companies.

Super cloud computing architecture to solve combinational problems.

- Traditionally, applications for solving combinational problems are based on desktop applications.
- Using the new paradigm of software as a service (SAAS) platform has been built for solving combinatorial optimization problems. The following problems are solved using MILP and Ant Colony Optimization (ACO).
  - The Vehicle routing problem (VRP).
  - Fleet assignment problem (FAP).
  - Tactical planning staff problem (WFP).

Study on information transition to facilitate sustainable consumption: multi-stakeholders viewpoints.

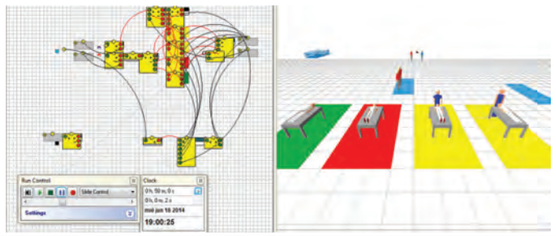
- From both practical and theoretical studies, it is necessary to strengthen information transition and provide a facilitator to bridge the gap between consumers' attitude and behavior.
- This study focused on the in-depth understanding of how to provide a facilitator within Attitude-Facilitator-Infrastructure (AFI) framework in order to provide incentives for promoting sustainable consumption.

International Manufacturing Network-Operational Issues and reshoring

- Globalization is not a new phenomenon. However, companies are facing challenges with international manufacturing, and in recent years, there has been a growing interest in the phenomenon of reshoring or back shoring.
- From these perspectives, this research intends to contribute in the area of international manufacturing strategy by investigating the operational issues of manufacturing network that have implications on networks

Health care optimization

- A mixed integer programming and simulation model was developed for the operation rooms schedule.
- We are working in the modeling and simulation of the Urgent Care centers.



Coslada Smart logistics Competition.

We organize this competition to:

- Spread the concept of Smart City among students and citizens for those who are not aware of it yet, provide information on the state of the art in this sector and on the initiatives that are taking place in other countries.
- Detect innovative and feasible ideas, applicable to the city of Coslada, or any other city with similar characteristics.
- Contribute to the evaluation of the best ideas attending to the evaluation criteria which are pointed out in this text.
- Reward the best projects.

Optimization and Simulation for aero structure plant.

- We implement a discrete model to build the schedule for the Job Shop scheduling problem with operators and a simulation model for the Fan Cowl manufacturing..
- A discrete and continuous approach was designed for the production schedule of aero structures with shared resources.

Members.

- Miguel Ortega Mier
- Alvaro Garcia Sanchez
- Tamara Sanchez Borreguero
- Raul Pulido Martinez
- Ahmed Sayem
- Luis Miguel Arreche Bedia
- Joaquin Delgado Hipolito
- Eva Maria Ponce Cueto
- Francisco Javier Diego Martin
- Jose Angel Gonzalez Manteca

Ingeniería Sísmica: Dinámica de Suelos y Estructuras

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http://http://www.upm.es/observatorio/vi/index.jsp?pageac=grupo.jsp&idGrupo=225

Research Team

The research group includes 19 members from different disciplines. They belong to 3 Schools in UPM (ETSI Industriales, ETSI Topografía, Geodesia y Cartografía and ETSI Aeronáutica y del Espacio) and to the University UNED. Moreover, the team is part of the 'Global Change and New Energies' from CEI Moncloa Cluster. Some members of the group also take part in GeoAlerta, a UPM Cooperation Group.

Our work

The group is a benchmark in Spain in the field of earthquake engineering, seismic hazard, vulnerability and seismic risk. The group has worked on the location of vulnerable structures subjected to seismic hazard and participates in the development of Spanish and European Seismic Codes (NCSE and Eurocodes). The group is involved in the development of advanced technologies based on the passive control for protecting structures against earthquakes. This includes the research on new energy dissipation devices and new methods for designing structures with this type of devices. The group is also very active in the analysis and control of vibrations due to the human activity, traffic, etc. Members of the group are also involved in related areas such as geoscience, organization and geo-referenced information and SIG systems.

Collaborations. Social implication

The group collaborates with different national and international agencies, focusing mainly in the Latin America countries, where many research projects are been developed.

Likewise, education has a crucial importance in the group. For this reason, the members actively participate as professors in the Master Degree 'Ingeniería Sísmica: Dinámica de Suelos y Estructuras' of the UPM. The aim is to form researchers and trained professionals that can be recruited by either Research Groups or R&D Departments from companies.

The work developed by the group has deep social implications. For instance, after Haiti Earthquake or Lorca Earthquake, members of the group participated in post earthquake evaluation of damage and in the development of seismic upgrading strategies. In order to disseminate the knowledge produced by the group, the members regularly publish in top international journals.

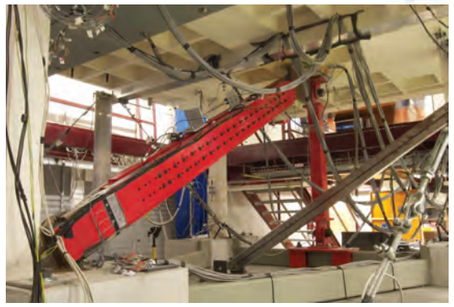
Testing facilities

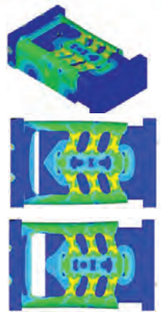
The group has a structural laboratory located in the ETS Ingenieros Industriales (UPM) whose equipment is composed of a seismic simulator, dynamic actuators, data acquisition systems and different equipment to perform dynamic tests.

Research Lines

1.- Passive control of structures subjected to seismic loading

Special systems able to dissipate large amounts of energy under seismic actions are investigated in order to avoid or minimize damage in the main structure under a large earthquake. The basic system is based on installing energy dissipation devices or dampers in the building. The research on this topic encompasses both the development of new energy dissipation devices and the proposal of new mathematical models and methods to design structures with passive control systems. Energy dissipation systems is a growing technology already used in Japan and USA but scarcely in Europe.





2.- Seismic hazard, vulnerability and seismic risk

Seismic hazard (P): studies on this topic deal with the probability of occurrence of large ground motion in certain area in a time period. They have been applied for:

Defining the Spanish seismic hazard map

Locate a nuclear waste warehouse:

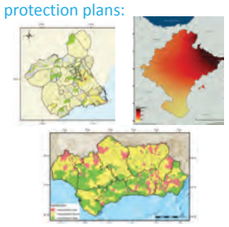
Seismic hazard:
P x V x Exposition x Cost

Vulnerability (V): evaluates the expected seismic damage on a structural typology. Applied to:

Gas pipelines:

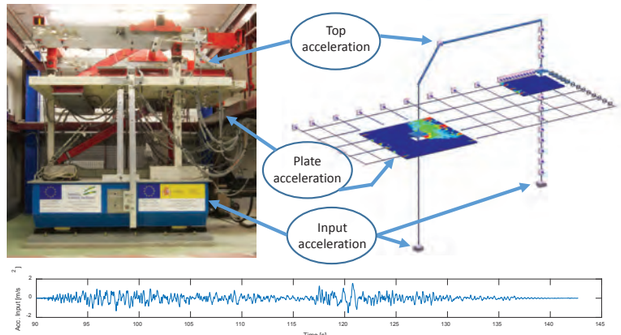
Buildings

Civil protection plans:

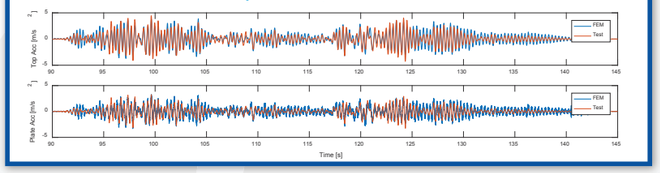


3.- Numerical simulations for dynamic analysis of structures

Numerical simulations are performed on numerical models calibrated with the experimental results of scaled structures tested in shaking tables:



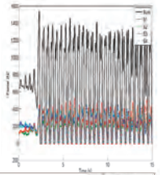
Good agreement is typically found between simulations and experimental tests in terms of acceleration, displacement, forces etc.

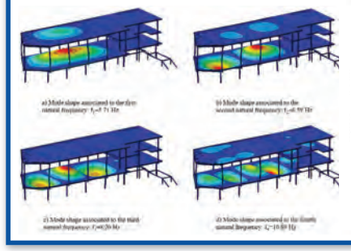


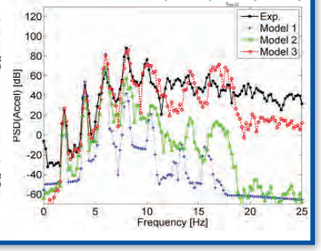
4.- Analysis and vibration control of structures

Human activities such as walking, dancing, jumping, running and aerobic exercises are regarded as the most severe sources of dynamic excitation on structures. Therefore, there is a concern among researchers to evaluate the dynamic behavior of structures under human activity effects.

Evaluating the dynamic response involves the development of detailed finite element models of the structures and calibration with experimental results. One example is the Gymnasium of ETSII in UPM:

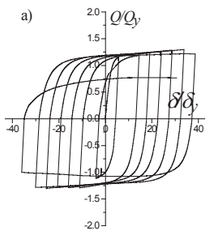


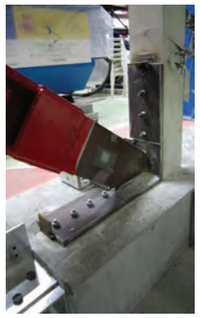




5.- Seismic retrofitting of structures

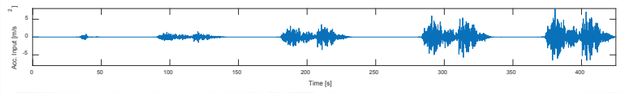
A large number of current structures were built in seismic areas using old standards. They were design using seismic design methods based merely on forces (force-based approach) without taking into account ductility considerations. Currently, this type of structures are of particular concern since they are very prone to suffer severe damage or even collapse under large earthquakes. We investigate on the seismic upgrading of this type of existing structures using modern techniques. This research line includes conventional and advanced technologies based on passive control.

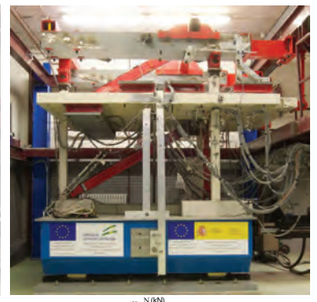


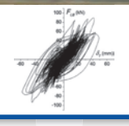


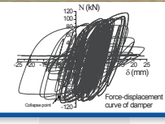
6.- Seismic behavior of structures using shaking table test

The group has a large experience in conducting shaking table tests to study the seismic response of structures under seismic loading. One example are the recent experiments conducted on waffle-flat plate systems with and without energy dissipation devices, subjected to seismic simulations on increasing intensity:









INDUSTRIALES RESEARCH MEETING 17

Grupo de Investigación en Instrumentación y Acústica Aplicada

info@i2a2.upm.es, http://www.i2a2.upm.es/

POLITÉCNICA

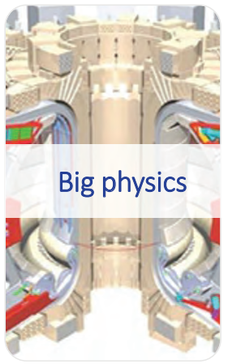
ADVANCED INSTRUMENTATION & ELECTRONICS

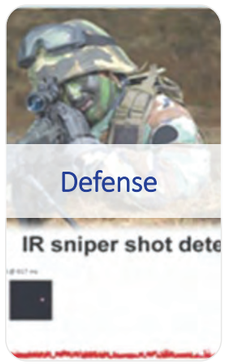
- Data Acquisition & Processing Architectures
- Structural Health Monitoring
- Sensing Technologies

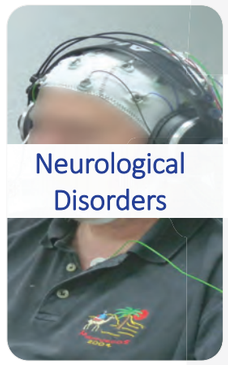
APPLIED ACOUSTICS

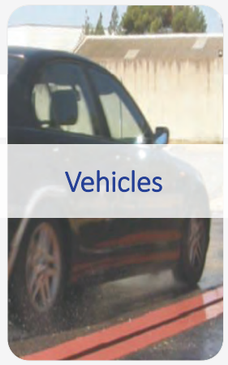
- Noise Control
- Sound Quality
- Neuroacoustics
- Instrumentation & Metrology
- Noise Pollution

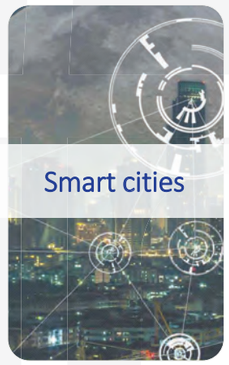
APPLICATIONS











INDUSTRIALES RESEARCH MEETING 17

Grupo de Investigación en Fabricación

http://fabricacion.etsii.upm.es

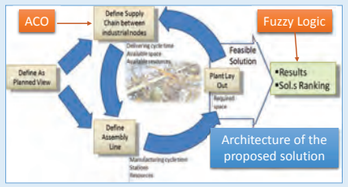
POLITÉCNICA

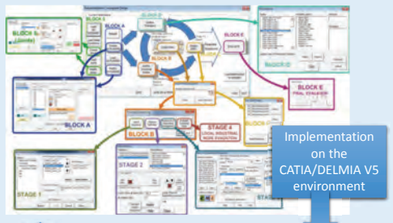
MAIN LINES OF RESEARCH:

•Digital Manufacturing & Knowledge Based Engineering

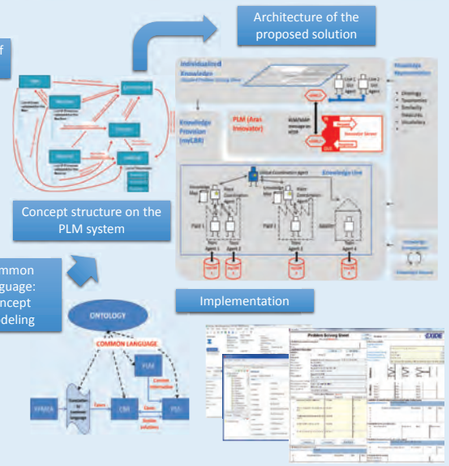
Collaborative systems development using IT integrated applications to define , simulate and control resources and manufacturing.

Creation and evaluation of multi-criteria conceptual solutions of the design of assembly lines of final mounting in the aeronautics sector.





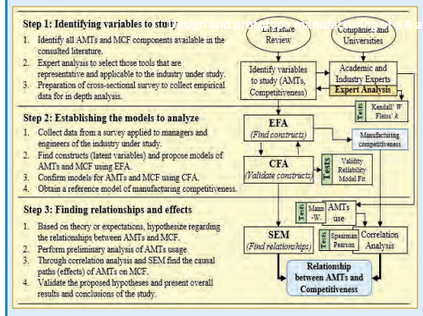
Continuous improvement in manufacturing using a multi agent platform that introduces product life management (PLM) and case based reasoning (CBR).

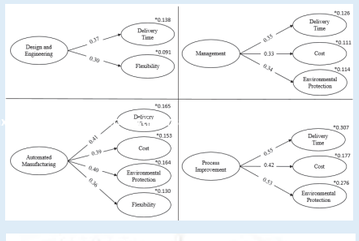


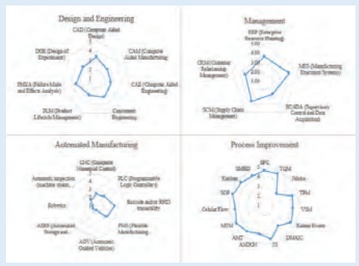
• Manufacturing performance measurement & optimization

Development of methods and IT architectures for the measurement and improvement of manufacturing systems

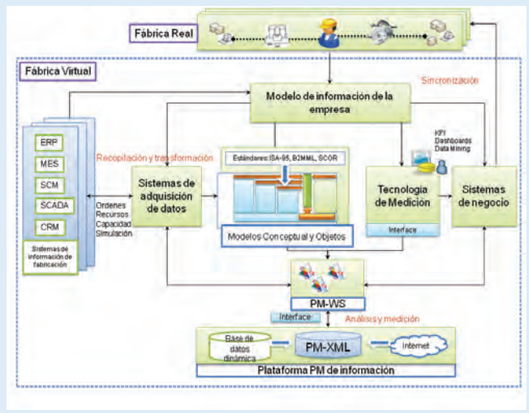
A method for estimating the influence of advanced manufacturing tools on the manufacturing competitiveness of Maquiladoras in the apparel industry in Central America







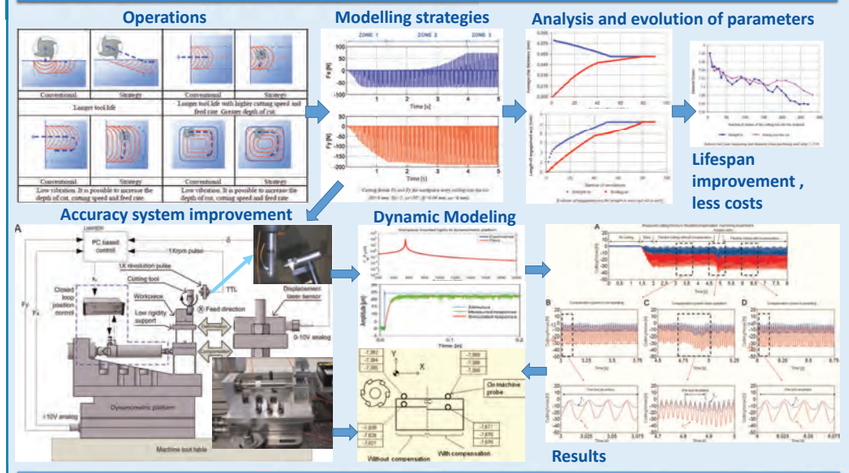
Performance measurement integrated information framework in e- Manufacturing



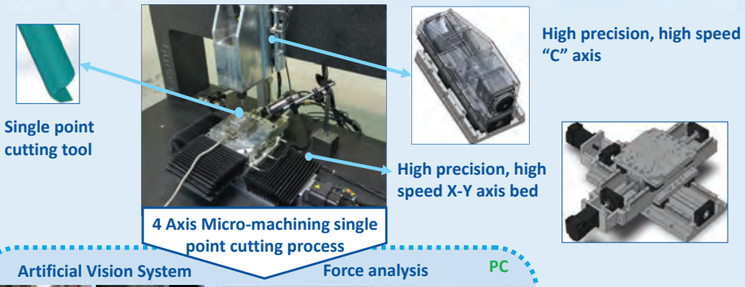
•Manufacturing Processes and Micro manufacturing

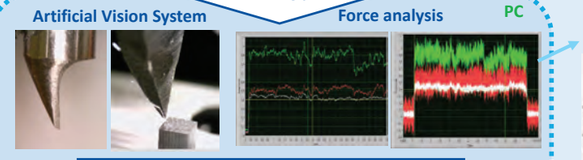
Development and optimizing automation of manufacturing process

Real time milling process optimization



Design and prototype manufacturing of a 4 axis single point micro cutting machine





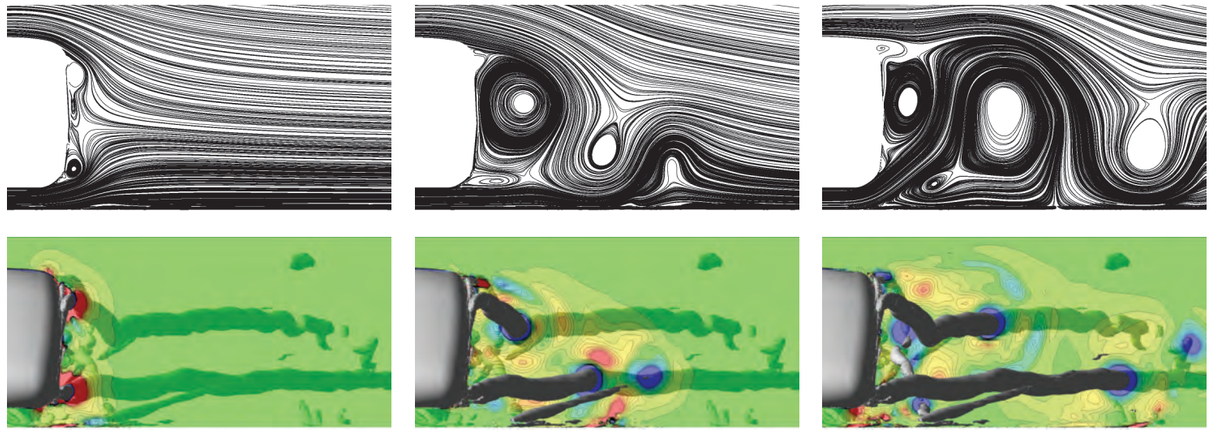
Double X-Y Bed System

A second bed system uses piezo-electric actuators give the system extra precision

Mecánica de fluidos aplicada a la Ingeniería Industrial

http://fluidos.etsii.upm.es/

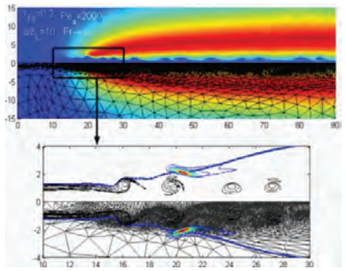
Train Aerodynamics (J. García, J. Muñoz)



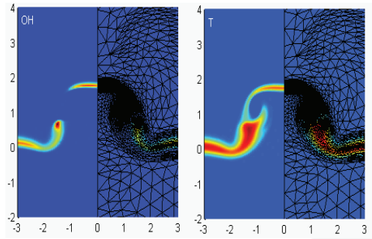
Pathlines and vortex core location at three cross-sections from the train nose tip. From left to right, x/L = 0.14, x/L = 0.44 and x/L = 0.75, where L is the train length. Second row of figures includes also instantaneous flow structures using iso-contours of Q (positive values of second invariant of velocity gradient tensor).

The requirements for an efficient mean of transportation are met in high-speed trains, what has attracted much attention from researchers to develop lighter and faster trains. A consequence of this is the introduction of new aerodynamic problems that were neglected before. Our group has been working for more than 10 years, also collaborating with top companies in this area (CAF S.A.) in the **analysis of the flow characteristics and aerodynamic optimization of high-speed trains**. These studies involve zero-yaw wind, crosswind stability, entry in tunnels and pressure waves inside tunnels, trains passing by each other, ballast uprise or flow description in bogies and pantographs. **Computational Fluid Dynamics** (CFD) is used for such purposes, using both commercial (ANSYS Fluent) and open-source software (OpenFOAM). Nevertheless, the wind tunnel located at our laboratory has been used for validation of scaled models aerodynamic studies.

Research in Numerical Methods for Fluid Dynamics Applications (J. Carpio, J.L. Prieto)



Propagation of triple flames.



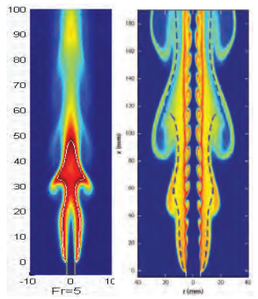
Diffusion-flame vortex interation.

Numerical techniques:

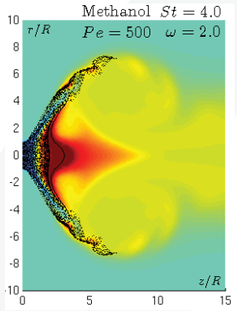
Anisotropic mesh adaptation.
A posteriori error estimator.
Lagrange-Galerkin methods to treat convective terms.
Level-set techniques to define free-surfaces.

Application problems:

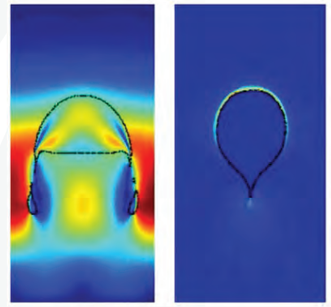
Reactive flows.
Multiphase flows
Non-Newtonian fluids.



Buoyancy instabilities in flames.

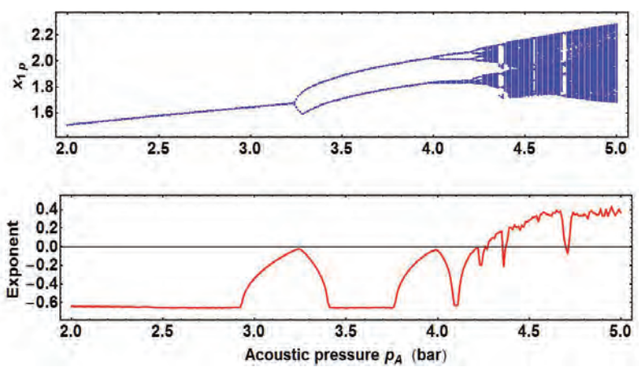


Vortex breakdown in spray combustion.



Rising bubbles in Newtonian and non-Newtonian fluids.

Bubble Dynamics: Biomedical Applications (J. Jiménez)



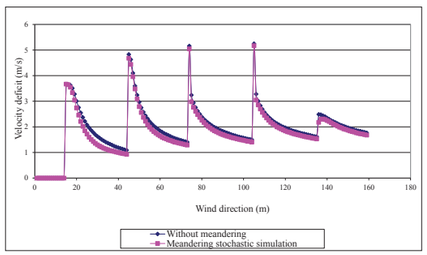
As the acoustic forcing is increased, the nonlinear response may become chaotic. Regular and chaotic behavior: Bifurcation diagram and Lyapunov exponents for radial oscillations of an encapsulated bubble irradiated by an ultrasound field . The incident pressure amplitude is the control parameter.

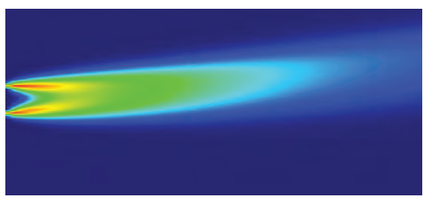
Gas-filled microbubbles stabilized against dissolution by lipid, polymeric or albumin shells , irradiated by an ultrasound field, enhance the acoustic backscattering from blood-filled regions and hence improve diagnostic ultrasound imaging.
They may be also used for targeted therapeutic gene and drug delivery

Recent application:
The subharmonic response in the signal scattered by contrast microbubbles is very sensitive to ambient pressure variations. This dependence, provides a non-invasive procedure for local blood pressure estimations

To fulfil the above applications, the dynamic and sound emission of encapsulated gas bubbles must be investigated by including in the analysis elastic and viscous properties of the encapsulating layer.

Wind Energy: Wake Meandering (E. Migoya, A. Crespo)

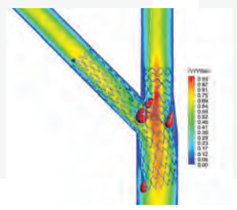




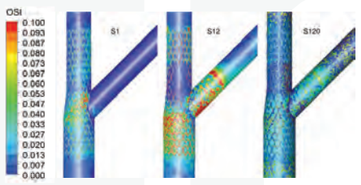
Instantaneous profiles: Distribution of k

A stochastic simulation has been implemented to take into account the meandering wake. Changes in the wind characteristics due to large sale turbulence have been retained and incorporated simultaneously to UPMPARK. Kaimal and Von Karman spectrum could be employed using as datum average and variance incident wind speed, average incident wind direction and scale parameter of turbulence.

Stented Coronary Arteries (J. García, F. Manuel)



Stent implantation is a common procedure followed in arteries affected by atherosclerosis. That procedure can lead to other stenting-related problems. One of these is the deposition and accumulation of blood clots on stent struts. This process can have further consequences, because it can introduce modifications on the flow pattern. This problem is especially critical in stented bifurcations, where resulting stent geometry is more complex.



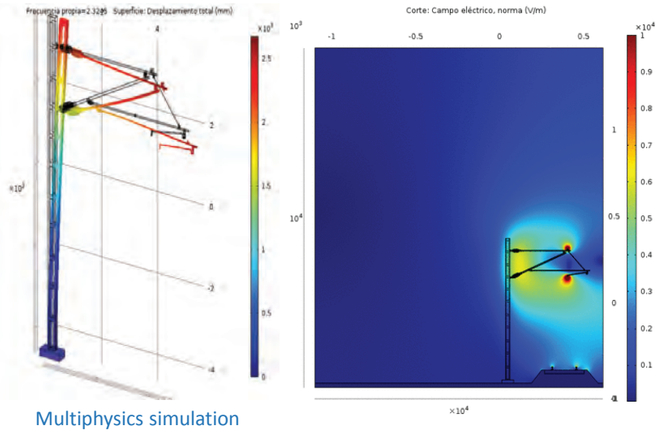
A numerical study of the effect on the flow pattern and platelet activation of blood clot depositions over stent struts of a stented coronary bifurcation is presented. Afterwards, the influence of the presence of thrombi depositions on parameters as Oscillatory Shear Index (OSI) is analyzed.

INDUSTRIALES RESEARCH MEETING 17

Grupo de Investigación en Modelado y Simulación en Ingeniería Mecánica

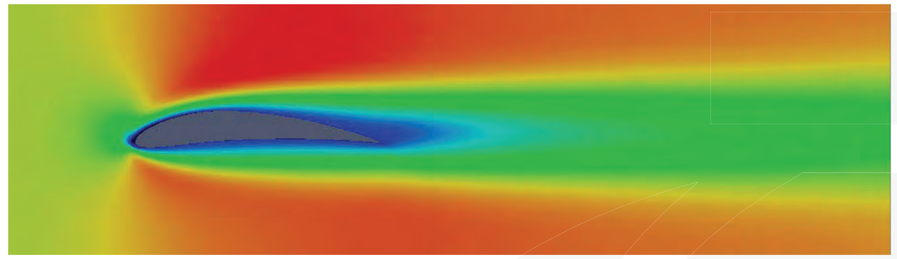
simula.dimec.etsii.upm.es

POLITÉCNICA

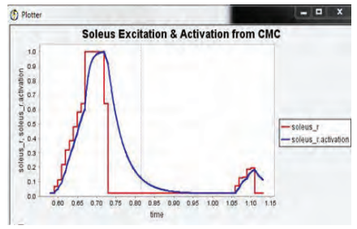


Multiphysics simulation
Electric and magnetic field coupling in railway electrification systems

Mechanical design and simulation.
Railway dynamics

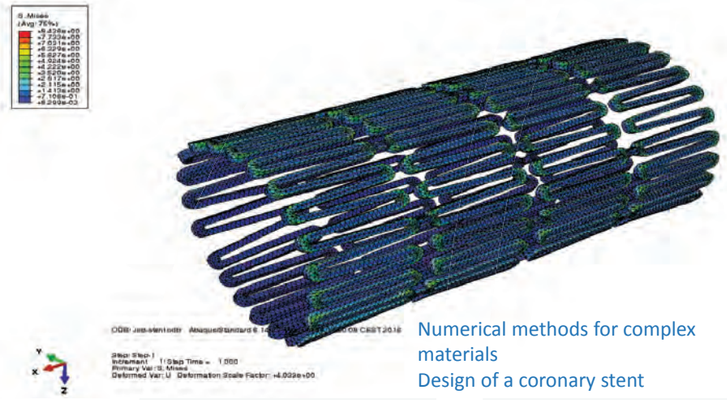


Finite elements for fluid mechanics
Blade design for a wind turbine

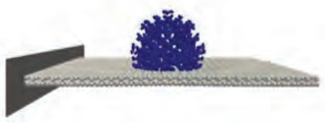


Biomechanical analysis
Sports and ergonomic applications

Mechanics Modeling Methods Meshfree Simulation Computer-Aided Biomechanics Multiphysics Nonlinear Mechatronics



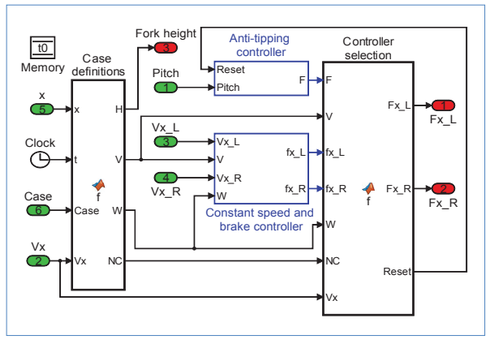
Numerical methods for complex materials
Design of a coronary stent



$t = 0.45$ s

$t = 0.55$ s

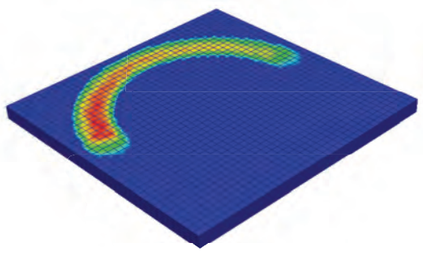
Numerical methods for simulation of fluid/structure interaction
Water impact on highly deformable structure

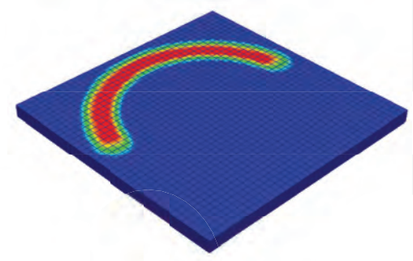


Mechatronic systems
Controlled vehicles. Stability and self driving

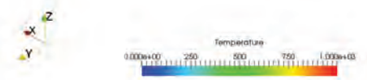
$t = 0.65$ s

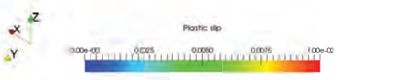
$t = 0.75$ s





Coupling problems
Welding simulation





Grupo de Investigaciones Termoenergéticas GIT

mval@etsii.upm.es

GIT context

- Founded in 2006 by Prof. José Mª Martínez-Val
- Composed by researchers from ETSII-UPM, ETSIME-UPM & ETSII-UNED (Departments of Energy) related to topics as Heat Transfer, Thermal Engines, Fluid Mechanics and Nuclear

Aim

- Sustainable development in the field of energy generation and energy efficiency

Current research lines

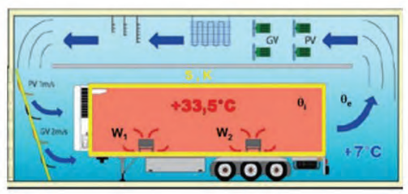
- Decarburation of natural gas for its exploitation without Greenhouse gases emission (near 1500 K)
- Concentrated solar thermal power: cost reduction through simplification of the designs (new Fresnel concepts) and gas-hybrid concepts (near 700 K)
- Solar cooling by absorption cycles (500 K)
- Concentrated photovoltaics, thermal behavior to improve solar cell performance (near 350 K)
- Near Zero Consumption Buildings (near 300 K)
- Cryogenics for superconductors (below 30 K)

1500 K

700 K

700 K

20 K



Temperature the key point… how to measure and control it?

- ATP Test Station placed in Getafe, Madrid
- Testing and calibration services of thermal refrigeration and legal metrology

DECARGAS project

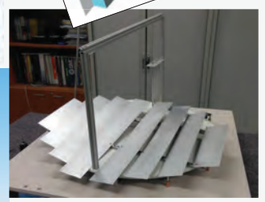
- Cracking methane without CO2 emission
- 78% conversion rate, obtaining H_2 high purity
- 2nd prize in *Innovatech* competition 2016

FUTURO SOLAR project

- New concentrated solar thermal receiver concept
- Built in Tecnogetafe
- 300 kWth
- Supported by CDTI Grant

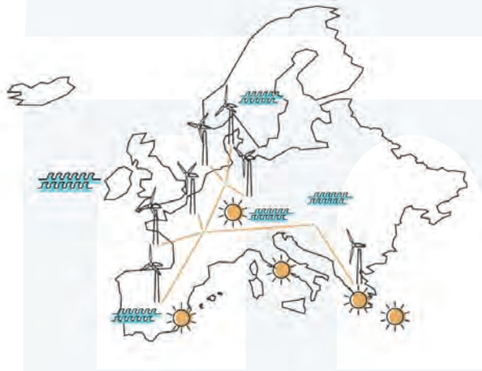
SUNDIAL project

- Evolution of FUTURO SOLAR project
- To be Built in *Tecnogetafe* before summer 2017
- 30 kWth
- Supported buy own founds
- 3rd prize in *Innovatech* competition 2016



BEST PATHS – Transmission of Sustainability project

- European Union's 7th Program for research, technological development and demonstration under grant agreement No 612748. October 2014 – September 2018
- The focus of the demonstrations is to deliver solutions to allow the transition to High Voltage Direct Current (HVDC) lines
- Integrate superconducting high power links within AC meshed network



OPTICS, PHOTONICS AND BIOPHOTONICS

m.holgado@upm.es, http://ctb.upm.es/?page_id=4182

INDUSTRIALES RESEARCH MEETING 17

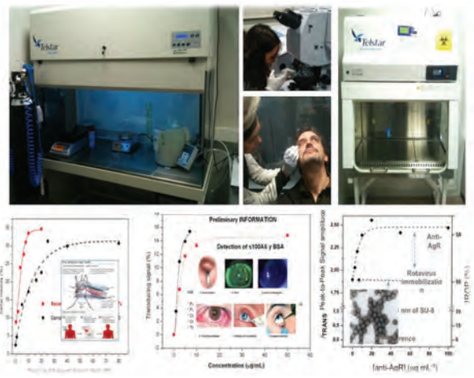
- Prof. Dr. Miguel Holgado Bolaños
- Prof. Dra. María Fe Laguna Heras
- Prof. Dr. Rafael Casquel Del Campo
- Prof. Dr. Álvaro Lavín Hueros
- Dr. Victor Canalejas Tejero (Post Doc)
- Invited Dr. Francisco Javier Sanza Gutiérrez
- PhD candidate: Ana Lopez Hernández (M.Sc.)
- PhD candidate: Betxu Santamaría Fernandez (M.Sc)
- PhD candidate: Mavi Maigler López (M.Sc)
- PhD candidate: Sergio Quintero Moreno (M.Sc)
- PhD candidate: Rocio López Espinosa (M.Sc)
- PhD candidate: Yolanda Ramirez
- Master Candidate: Sun Xiangyu
- Máster Candidate: Lara stolzenburg veeser

Research Lines

- Photonic transducers: **Label-free Biosensing**
- Optical read-out platforms: **Point-of-Care devices**
- Packaging and KITs: **Multiplexing easy to use**
- Micro-nano fluidics: **Lab-on-a-chip**
- Fluidic chips: **Cells-on-a-chip**
- Surface functionalization: **Bio-receptors and applications**

Experimental techniques:

- Micrometric high resolution UV-VIS-NIR Spectrometry
- Micrometric UV-VIS Spectrometry
- Sub-micron ellipsometry and reflectometry
- Photo-lithography and nano-imprinting (up to 6")
- Thin films deposition
- Continuous flow of liquids



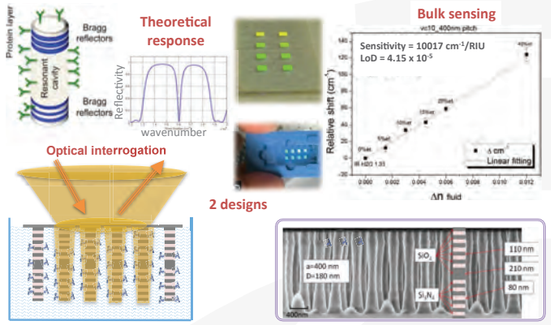
Applications:

- Clinical detection: **Label-free biosensing**
- Environmental detection: **Chemical and pathogens**
- Chemical detection: **Analysis of fluid components**
- Medicaments screening: **High Throughput Screening**
- Disposable biochips: **Cost-effective detection**

Spin-off:

- Bio Optical Detection www.biod.es: **Industrial exploitation**

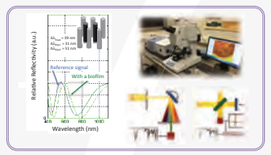
Our technology for Photonic Transducers



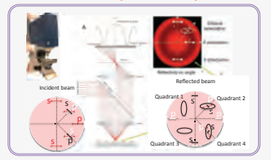
Our technology for optical readers and Point of Care devices

Optical readout Techniques

Broadband-based optical techniques



Laser-based optical techniques



Visible and IR Spectrometry (VIS-IR-SPEC)
Reflectivity as a function of wavelength by using dispersive media such as diffraction gratings. Broadband spectrums from UV-VI-NIR are easily obtained. From 470 to 1100 nm the spot size of 2.5 µm was achieved.

Fourier Transform Visible-IR Spectrometry (FT-VIS-IR)
It is an alternative to dispersive spectrometry with may have better signal-noise ratio, higher throughput radiation.

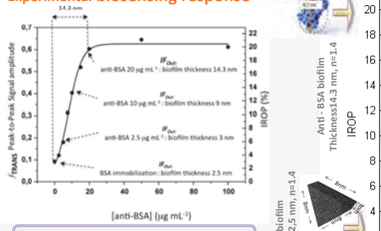
Sub-micron size Reflectometry
Reflectivity as a function of angle of incidence obtained in micro or sub-micro domains (subject to the diffraction limit).

Sub-micron size Ellipsometry
Equivalent ellipsometry measurement performed simultaneously with the same laser. It is also used a quarter-wave plate, an analyzer and a quad-cell detector.

Bio-applications and industrial exploitations

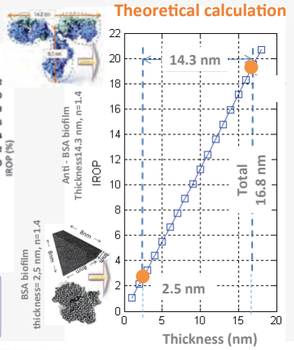
Biomolecular size

Experimental biosensing response

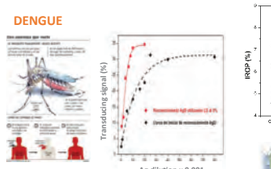


- Assay: BSA + anti-BSA
- Transducer: FP interferometer
- Readout tech: IROP

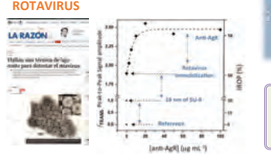
Theoretical calculation

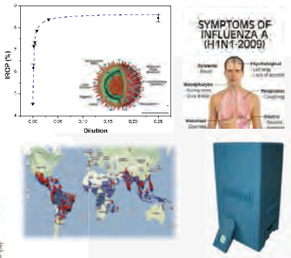


DENGUE



ROTAVIRUS

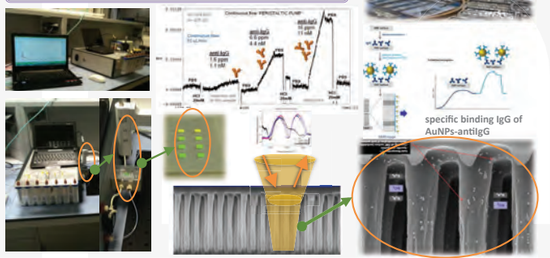




- Assay: Viral antigens
- Transducer: FP interferometer
- Readout tech: IROP + spectrometry

Aquiculture IVD in real time

- Assays: IgG + anti-IgG and IgG + IgG + AuNPs
- Transducer: BICELLs of resonant nano-pillars
- Readout tech: Spectrometry + Δ IROP (%)

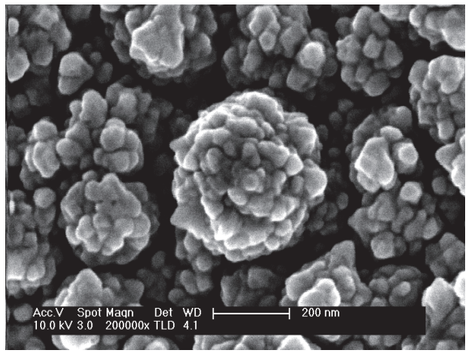


Grupo de Investigación “POLímeros: Caracterización y Aplicaciones” (POLCA)

gi.polimeros@upm.es

POLCA: basic data.

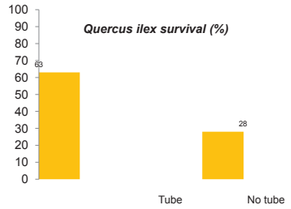
- Founded in 2005
- Associated Unit to Instituto de Ciencia y Tecnología de Polímeros (CSIC) since 2008
- 11 permanent members (from Universidad Politécnica de Madrid and Universidad Complutense de Madrid)
- 2 PhD students
- The Group has received competitive finnancial support of Spanish Public Institutions (MEC, MICINN, MMA, MAEX, MINECO, CAM, …)
- The Group has participated in initiatives of UE-H2020 (EIT Raw Materials)
- The Group has received finnancial support of private and public companies (Repsol Química, Ecoembes, EPCOS, BEFESA, Metro Madrid, ...)
- Collaborations with Universities and Research Centers from African, American, Asian and European countries.



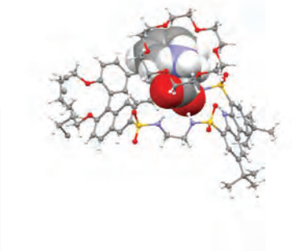
SEM image of Au nanoparticles modified with FPP

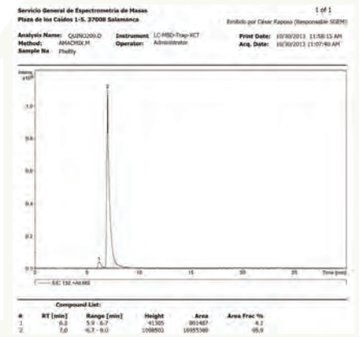
Main research lines

- Biopolymers based composites and nanocomposites
- Mechanical recycling of waste urban and agricultural plastics.
- Applications of recycled materials (packaging, tube shelters for restoring mediterranean forests, ..)



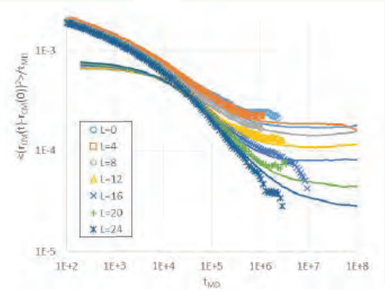
- Development of organic materials for photovoltaic devices including carbazole-based polymers and self assembled structures.
- Design and synthesis of artificial receptors for catalysis and chiral discrimination of target molecules





Enantioselective extraction of aminoacides

- Self-diffusion, rheology and chain dynamics in supramolecular networks
- Dynamics of Rod-Coil-Rod Triblock Copolymers with potential use as nanostructured soft materials with functional domains in organic electronics and biomaterial applications



Mean-square displacement of the center of mass of symmetric rod-coil-rod block copolymers of molecular weight and different rod lengths

- Biosensores for redox proccesses based on electrodes modified with organometallic macromolecules
- Nanoparticles deposition on polymeric and dendrimers

Project Management and Quality Research Team

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INDUSTRIALES RESEARCH MEETING 17

PMQ INDUSTRIALES ETSII | UPM

POLITÉCNICA

MEMBERS' PROFILE

Transference of knowledge
IPRs accredited
ISO committees
Well Age & Gender balanced
Academic & Professional expertise

DISSEMINATION

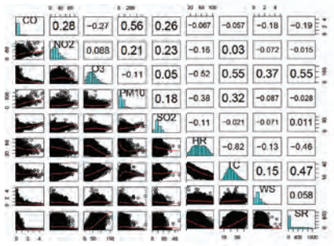
Conference attendance
JCR journal papers
Patents
Books

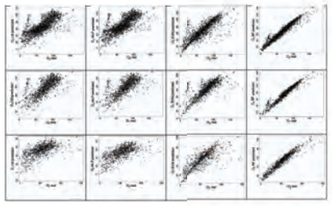
COMMITMENT WITH PhD STUDENTS

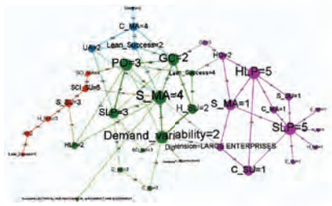
Prizes & Challenges
PhD monographs
Master thesis

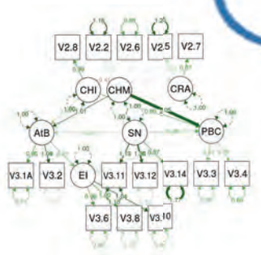
AREAS OF INTEREST

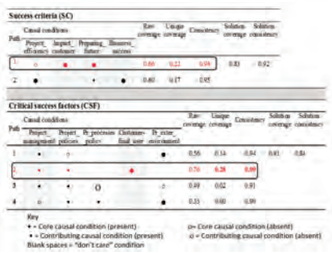
Diagnosis & Quality in Education
Business Analytics & Big Data
PM Sustainability
PM Competences
Industrial processes
Environmental Assessment & Recovery
Waste management in construction
Improving PM Methodologies
(...) ➔ Society challenges

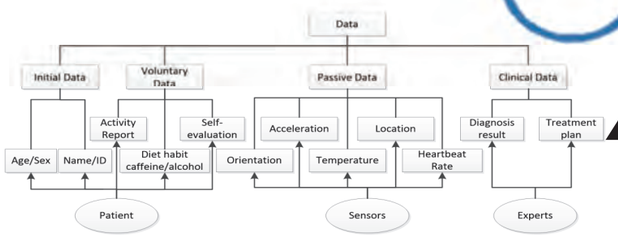


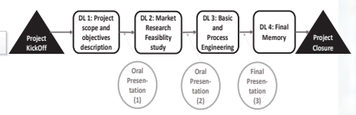


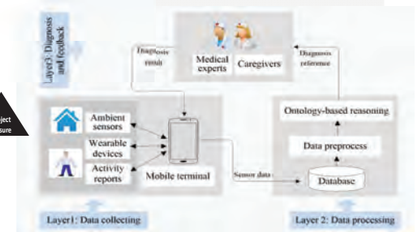


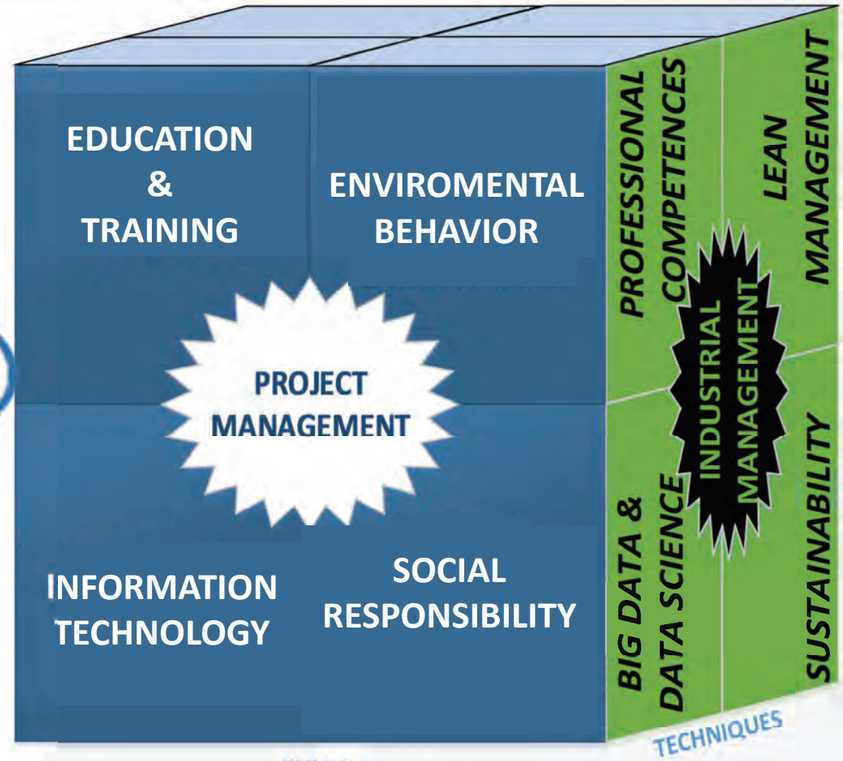


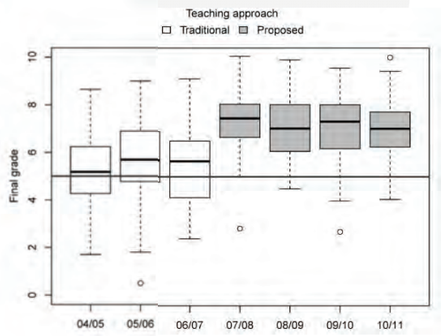


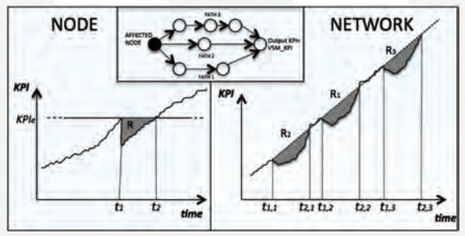












Grupo de Investigación en Tecnologías Ambientales y Recursos Industriales

(Environmental Technologies and Industrial Resources)

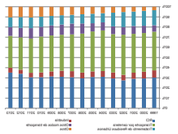
http://tarindustrial.etsii.upm.es
gi.tarindustrial@upm.es

About us

We are a multidisciplinary group of 17 people who belong to School of Industrial Engineering and School of Mining and Energy Engineering. In addition, we are part of the Global Change cluster and New Energies of CEI Moncloa. Our work is focused on three main research lines: AIR QUALITY, IMPROVEMENT OF INDUSTRIAL PROCESSES TO PREVENT POLLUTION and WASTE MANAGEMENT.

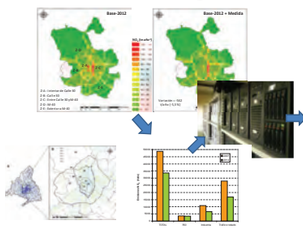
Air Quality

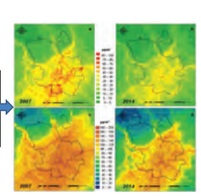
- Development of emission inventories: Madrid City
  - Fleet composition studies



- Estimation of air quality and GHG emissions, both direct and indirect
- Integration of traffic simulation and emission computation models

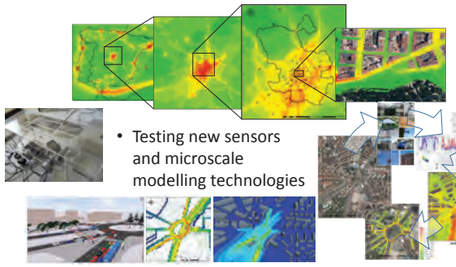
- Assessment of policies and measures through air quality modelling: Air Quality and Climate Change Plan for Madrid City





- Quantification of measures in terms of emission reduction and temporal and spatial allocation
- Simulation of the effect in ambient air quality through 3D mesoscale advanced chemical-transport models

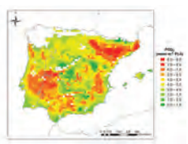
- Development of multiscale measurement and modelling technologies for urban environments: TECNAIRE-CM (www.tecnaire-cm.org)



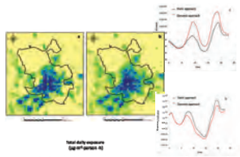
- Testing new sensors and microscale modelling technologies

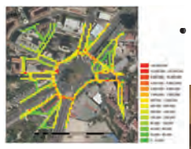
- Exposure and air quality-related impact assessment: health and vegetation

- $PM_{2.5}$-related premature deaths



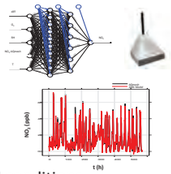
- Wheat exposure to O_3-fluxes





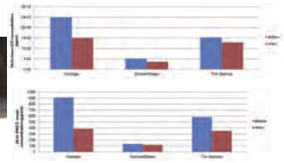
- Mobile phone data (CDRs) – derived mesoscale exposition and pedestrian modelling – derived microscale exposition

- Photocatalytic technologies on urban pavements: LIFE-PHOTOSCALING (http://www.life-photoscaling.eu)



- Assessing efficiency in real conditions

- Improved cookstoves and indoor air quality



Improvement of Industrial Processes

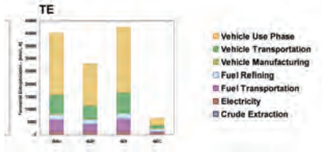
Clean Combustion Technologies

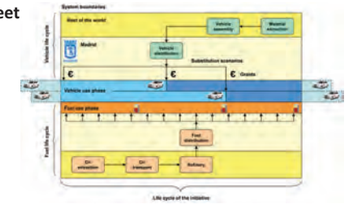
Coal is one of the main sources of energy employed to generate electricity, and its use represents the most competitive form of energy to increase the standard of living of any group or society, especially in non-developed or developing countries. However, climate policy has emerged particularly as a major driver for the future of coal for power generation in large parts of the world. Coal extraction globally results in the associated production of around 10 – 40% of waste coal, where higher values of waste coal correspond to underground than opencast mining. Waste coal production mainly vary on quantity, calorific value or energy content, ash, volatiles and different forms of sulphur content. It is principally obtained during coal mining and coal washing activities, resulting in about 15% and 85% of the total waste coal produced respectively, depending on the coal country producer and technology used for. As a result, large amounts of waste coal with important energy content remains available and are piled throughout coal country producers, that can be used in 'clean combustion technologies'. One of the most attractive technology is Integrated gasification in combined cycle and pre-combustion CO_2 removal process .

Life Cycle Assessment (LCA)

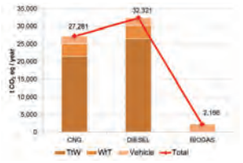
The Life Cycle Assessment (LCA) is a methodology used to quantify the potential environmental impacts of processes, products and services. It can be used as a corporate or governmental strategic planning instrument, especially oriented to design, supply and promote sustainable products (eco-friendly). This section contains some examples of LCA studies carried out in the TAR-Industrial research group, in order to show the usefulness of LCA methodology as an effective tool in decision-making process.

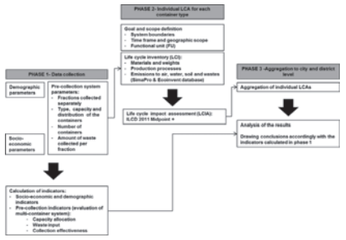
- **Evaluation of the environmental impact of Madrid taxi fleet under different renovation scenarios**



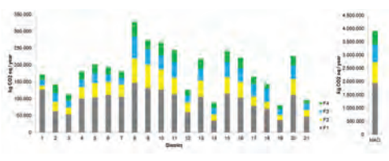


- **Carbon footprint (CF) of a brand of ecological wine**
- **Comparative LCA of conventional kerosene and bio-kerosene**
- **LCA of a diesel produced in a Spanish refinery**
- **CF of municipal solid waste (MSW) treatment stage**
- **CF of MSW transport fleet**





- **LCA of urban waste containers**



Waste Management

FARM Project on metals recycling from MSW energy recovery waste

The aim of the project is to develop an integrated process for the concentration and recycling of metals present in the ash and slag produced by the recovery of energy from Municipal Solid Waste (MSW), including metals considered to be of strategic value. In order to reduce the quantity of such metals being sent to landfill, whilst also reducing the dependency of EU Member States on the importation of these materials.

The project enables the combination, on an experimental scale, of processes based on the application of metallurgical and pyro-hydrometallurgical techniques. Our group has developed the metallurgical process.

Carbon Dioxide Capture and Valorisation: Sustainable Process Development and Integration

This project coordinates three of the best Spanish teams in Separation Processes (UC), Applied Electrochemistry (UA) and Environmental Technology (UPM) to develop sustainable carbon capture and valorization processes and its application to the municipal waste management (MSW)

Carbon Dioxide adsorption in chemical activated carbon from sewage sludge

Sewage sludge is a potential feedstock for producing activated carbons due to its carbonaceous content. Producing activated carbon from sewage sludge allows to use waste, otherwise difficult to deal with, to obtain added value adsorbents

Removal of siloxanes and other VOC in MSW landfill gas

The presence of some trace amounts of certain substances like siloxanes in the landfill gas can cause severe problems in the combustion engines

Gasification of Biowastes

Gasification technology has many advantages: no strict limits on the size and types of feedstock, the product gas can be utilized in various ways, compared with pyrolysis and direct combustion, and the utilization of gaseous fuel causes lower environmental impact.
Our group has been working in waste water sludge gasification for the past 8 years.

TACA Research Group: CONSTRUCTIVE APPROXIMATION IN SOME APPLICATIONS

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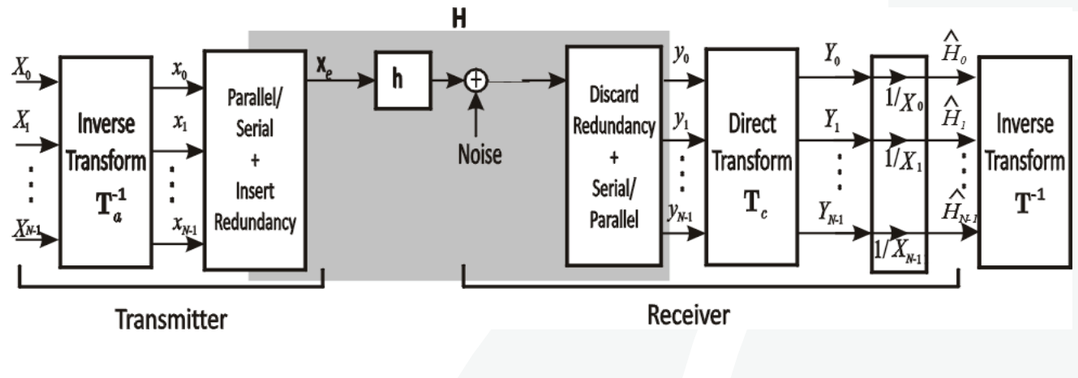
[c]ETS de Ingeniería Civil

Abstract

The UPM Research Group "Theory and Applications of Constructive Approximation" (TACA) is formed by mathematicians, physicists and engineers who collaborate in several research lines, by applying mathematical approximation methods to actual problems in Engineering. Here we present the most recent advances obtained by the members of this multidisciplinary group.

Channel estimation in wireless communications

In wireless communications, the channel filter **h** is usually time-varying, and we need to estimate it at the receiver. From the scheme given in the Figure, we give procedures to approximate **h** when a Discrete Cosine Transform (DCT) is considered as the transform **T** at both the transmitter and the receiver:



- In [1] we present an algorithm which achieves an accurate estimation of symmetric channel filters **h** by means of a small number of training symbols X_k ,when using type-I DCT (DCT1).
- In [2] a procedure is given for estimation of any kind of filter, for either DCT2 or DCT4.

Darboux transformations

•The Darboux transformations provide, joint with other applications, a method for obtaining solutions of some integrable systems. In [3], the concepts of Darboux factorization and Darboux transformations for arbitrary Hessenberg banded matrices are analyzed. Specifically, the existence of this kind of factorization is studied, and some sufficient conditions for the uniqueness are determined.
•In [4] the relation between the Darboux transformation and the solutions of the full Kostant Toda lattice is analyzed. The discrete Korteweg de Vries equation is used to obtain such solutions.

Quadrature formulas

A new class of numerical quadratures is defined intended to approximate the value of the integral and the error committed at the same time [5]. The quadratures so defined are suboptimal in the sense that exactly integrate polynomials of nearly the highest degree. It is proven that they exist in cases where the corresponding optimal rules do not. Besides, the quadrature weights are positive and the nodes of the quadrature are simple and belong to the interval of integration. These properties are proven for sufficiently large number of nodes and wide classes of weight functions.

Minimizing energy consumption in Railway Rapid Transit networks

Railway transportation is the cheapest land transportation mode. In spite of this and because this mode of transport accounts for almost 40% of the total demand for mobility, it is becoming increasingly important to adopt measures that make it more environmentally friendly and, among them, those that are focused on minimizing energy consumption. In [6] we tackle the problem of approximating the real cost of minimizing energy consumption in railway rapid transit networks, so that, estimations of the price to be paid for being ecological and accomplish the with environmental standards are given. This is done using a mathematical integer linear program.

References

[1] M. E. Domínguez, D. Luengo, G. Sansigre: "Estimation of Symmetric Channels for Discrete Cosine Transform Type-I Multi-carrier Systems: A Compressed Sensing Approach", The Scientific World Journal, vol. 2015, pp 1-11, 2015.
[2] F. Cruz, M. E. Domínguez, G. Sansigre, D. Luengo, M. Moonen, "DCT-based channel estimation for single-and multicarrier communications", *Signal Processing,* vol. 128, pp. 332–339, 2016.
[3] D. Barrios Rolanía, D. Manrique, On the existence of Darboux transformations for banded matrices, *Applied Mathematics and Computation*, vol. 253 (2015), pp. 116-125.
[4] D. Barrios Rolanía, Darboux tranformation and solutions of some integrable systems, submitted to *Applied Mathematics and Computation*.
[5] B. de la Calle Ysern, M. M. Spalevic "Modified Stieltjes polynomials and Gauss-Kronrod quadrature rules", preprint.
[6] D. Canca and A. Zarzo, Timetabling and Energy Consumption in Railway Rapid Transit Networks (Preprint 2017, submitted).

Grupo de Investigación Termodinámica Aplicada a la Ingeniería Industrial (TAII)

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Research on…

▪The group Thermodynamics Applied to Industrial Engineering (TAII) analyzes, models and optimizes energetic systems. We study conventional and renewable electricity generation plants as well as experimental designs and small systems. We maximize energetic and exergetic efficiencies and complete the analysis with economic and environmental studies, in a 4E Methodology approach. As well as commercial software, we have our own Group-developed software: PATITUG and CICLOGRAF, that combine outstanding thermodynamic performance and flexibility for process analysis.

▪Among the variety of processes analyzed, we have selected two very different examples:

- **Trigeneration system (power - H_2 - process heating) and CO_2 sequestration based on chemical-looping combustion (CLHG) (Figures 1, 2 and 3).**
- **Integrated Solar Combined Cycle Systems (ISCCS) (Figures 4, 5 and 6).**

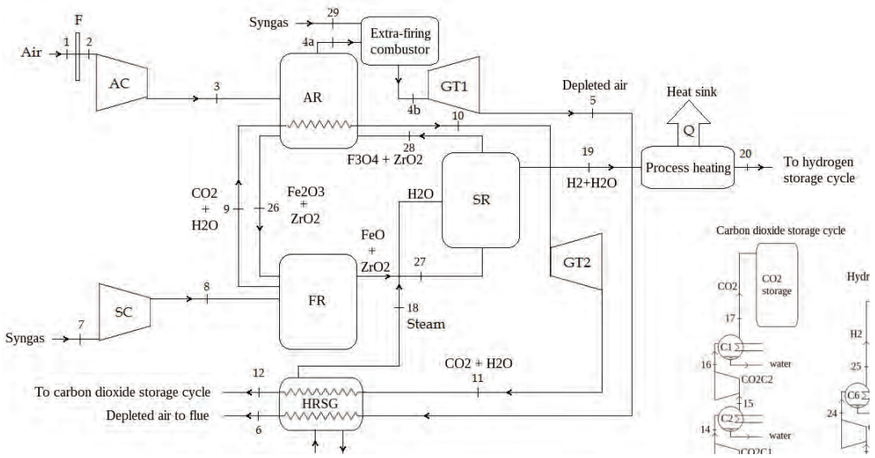

Figure1. Chemical looping cycle for trigeneration with CO2 sequestration.
A concept for highly efficient power generation with nearly zero greenhouse emissions.

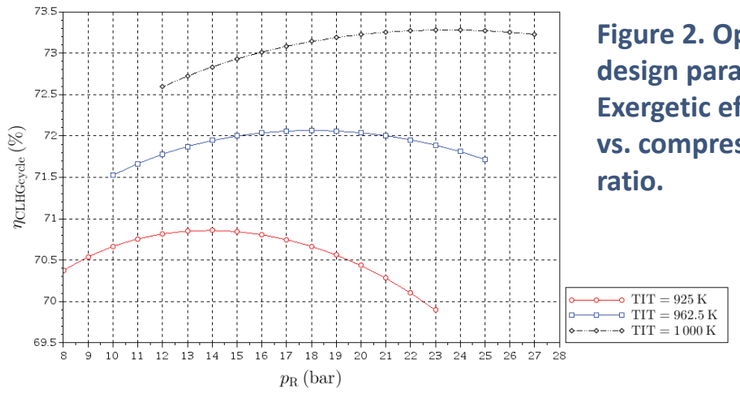

Figure 2. Optimal design parameters. Exergetic efficiency vs. compression ratio.

Parameter	Value
$\eta = \frac{W}{E_f + E_s} \cdot 100$	50,84
$\psi = \left(1 - \frac{I}{Ex_f + Ex_s}\right) \cdot 100$	53,26
$\Delta CO_2 = (M_{FM} - M_{HM}) \cdot f_{CO_2}$	4740 t
$LEC = \frac{C_1 CRF + \sum_i^n FC_i}{G}$	57,50 €/MWh

Figure 5. 4E Methodology results. Energetic(η) and exergetic (ψ) efficiencies, CO_2 emissions avoided and Levelized Energy Cost (LEC).

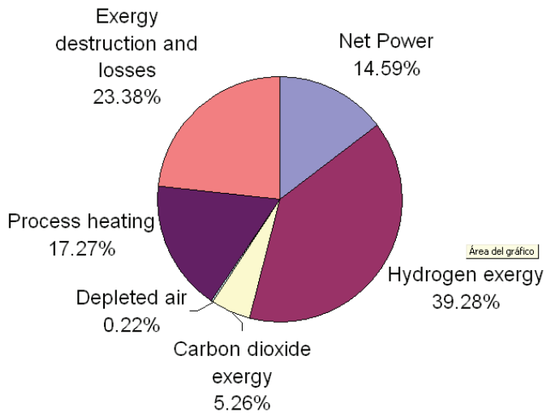

Figure 3. Exergy balance of CLHG cycle.

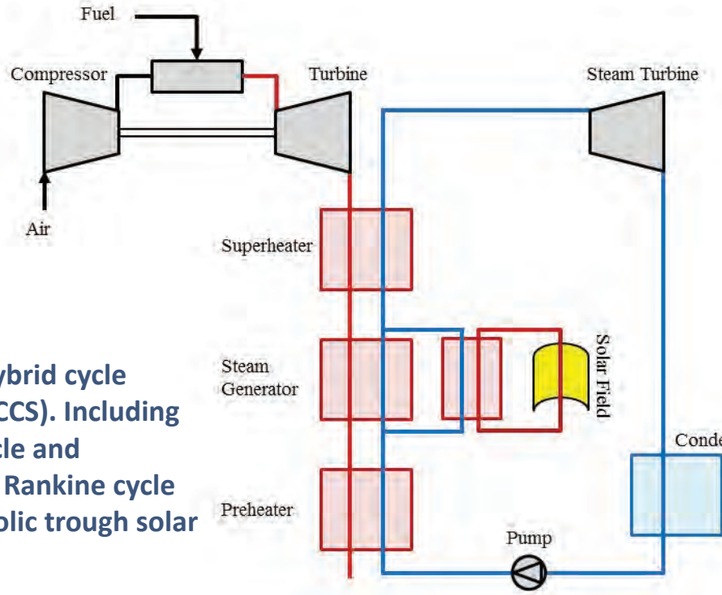

Figure 4. Hybrid cycle scheme (ISCCS). Including Brayton cycle and bottoming Rankine cycle with Parabolic trough solar collectors.

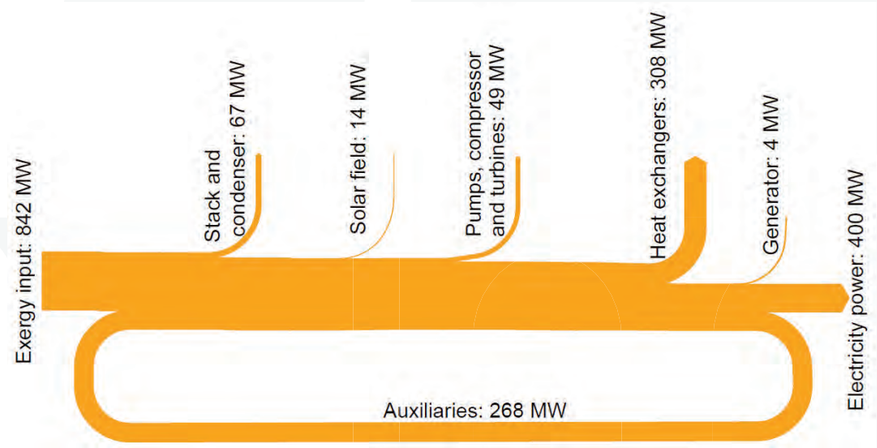

Figure 6. Exergy Grassmann Diagram of ISCCS.

MEETING VENUE

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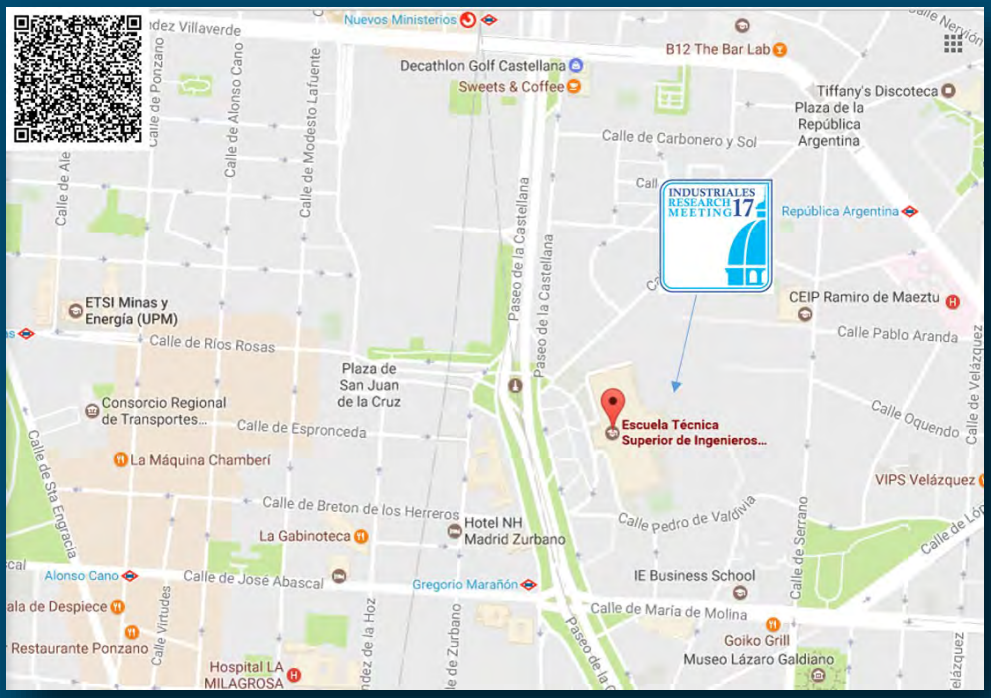

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